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WAR MACHINE

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Armed Forces of the World: French Air Force (Part 3)

The sinking of the *Belgrano*

Sturgeon in Action

Soviet Attack Submarines Methods and Tactics

A fully illustrated guide to the world's Modern Nuclear Attack Submarines

WAR MACHINE

Volume 3 **Issue 27**

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Armed Forces of the World

French Air Force (Part 3)

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U.S. AIR FORCE

WAR MACHINE

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- Armoured Vehicles of World War I
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- Air-to-air Missiles
- Strategic & Tactical Reconnaissance Aircraft
- Cruisers of World War II

Nuclear Attack Submarines

USS Jacksonville *is one of the 'Los Angeles' class attack submarines that are destined to serve with the US Navy into the 21st century as the primary underwater ASW platform. They carry Mk 48 torpedoes, Harpoon and Tomahawk SSMs and will be fitted for the ASWSOW (ASW Stand-Off Weapon) system to replace their SUBROC missiles.*

At this moment, beneath the surface of the ocean, a potentially deadly game of cat and mouse is being played between Soviet and NATO submariners. The prime tool of their trade is the modern nuclear attack and hunter-killer submarine, packed with weaponry and sensors and capable of operating at greater speeds and depths than ever before.

The development of the modern nuclear attack submarine started around the same time, in the late 1940s, in both the United States and the Soviet Union. Since then the two countries have developed their own characteristic designs, with the United States concentrating on the ASW-orientated boat (SSN) armed with torpedo tube-launched weapons, whilst the Soviets have also developed these craft and others (SSGN) specifically designed to carry large anti-ship cruise missiles. However, since the development of the Sub-Harpoon and Tomahawk underwater-launched missile systems for anti-ship and land attack roles, the American boats are gradually assuming a multi-mission capability.

The Soviets are also expected to move in this direction when their SS-NX-21 torpedo tube-launched nuclear cruise missile enters service later in the decade, although they will still be building the specialist cruise missile-carrying boats such as the 'Oscar' class, the underwater equivalent to the 'Kirov' class battle-cruisers. Currently the Soviets have five nuclear-powered attack submarine classes under construction: the 'Charlie III' SSGN, 'Oscar' SSGN, 'Alpha I' SSN, 'Victor III' SSN and, the newest, the 'Alpha II' SSN. In comparison the Americans, British and French have in construction only one SSN class apiece. The Soviets add between four and six boats of these five types to their fleet per year, with each class usually undergoing periodic updates to its systems and armament during its lifetime. The French and British boats are primarily for ASW work, whilst recently confirmed reports indicate that the People's Republic of China has six or so nuclear-powered attack boats in service. The first was built in 1973-4, and is 100 m (328 ft) long with an Albacore type hull for fast underwater speeds. Known as the 'Han' class, this model is expected to proliferate over the next few years. Other nations, including Argentina and Brazil, are known to be interested in acquiring nuclear submarines.

The main advantages of the nuclear attack submarine are its ability to remain submerged for virtually unlimited periods, its deep-diving capability, the sophisticated long-range sensor systems that it carries, and the high power output of its reactor that can be translated into very high underwater speeds. All of these can be utilized to the full in modern submarine warfare. In the ocean environment in which these hunter-killer submarines spend most of their lives, there is nothing in the marine world that can match them for guile and potential destructiveness.

The Royal Navy's 'Swiftsure' class submarine HMS Sovereign *on the surface amidst ice-floes during her 1976 visit to the North Pole. As the ice cap is a relatively safe place to operate a ballistic missile boat, more and more anti-submarine patrols are spent in Arctic waters.*

UK

'Valiant' and 'Churchill' class SSNs

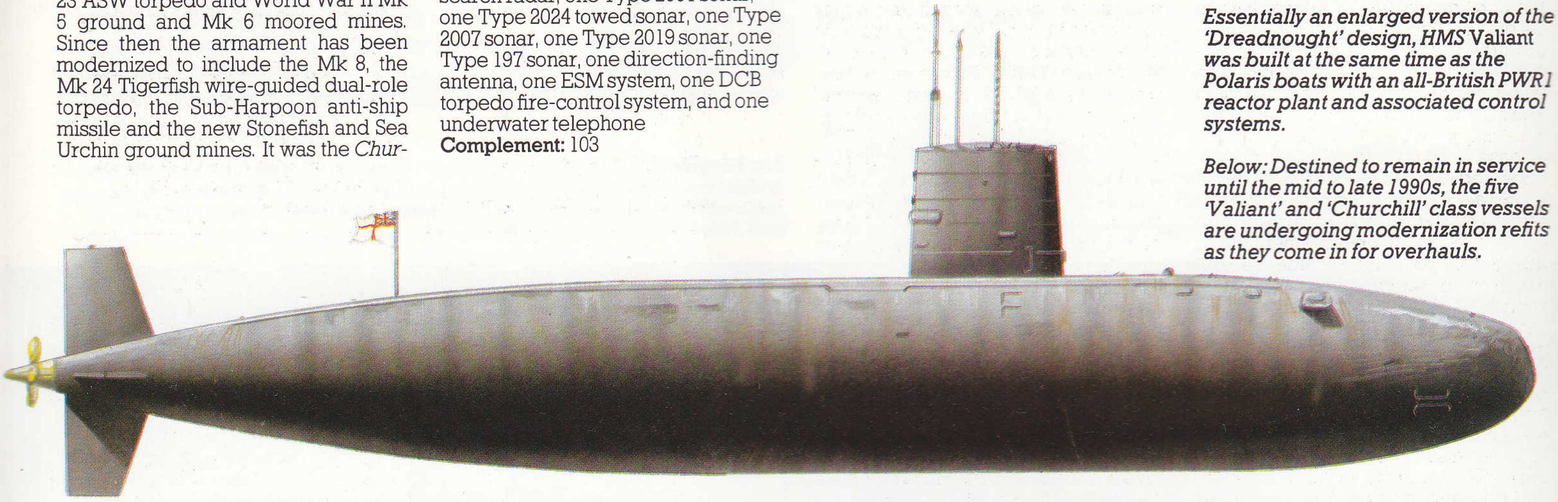
Essentially an enlarged 'Dreadnought' class design with all-British reactor plant and systems, HMS ***Valiant*** (S 102) was ordered in August 1960 as the lead boat of the **'Valiant' class** and completed in July 1966, a year later than planned because of the priority accorded to the British Polaris programme. Her sistership HMS ***Warspite*** (S 103) was followed by three others built to a modified design as **'Churchill' class** boats. These three are HMS ***Churchill*** (S 46), HMS ***Conqueror*** (S 48) and HMS ***Courageous*** (S 50), and are believed to be slightly quieter in service, having benefited from the experience gained in operating the earlier boats. All are fitted with the Type 2001 long-range active/passive LF sonar mounted in the 'chin' position, though the three boats will be retrofitted with the Type 2020 set as a replacement during future overhauls. It is also reported that the five boats can be fitted with a LF clip-on towed array since identified as the Type 2024 sonar system. Other sonars identified with the craft are the Type 2007 long-range passive set and the joint Anglo-Dutch-French Type 2019 Passive/Active Range and Intercept Sonar (PARIS). A Type 197 passive ranging sonar for detecting sonar transmissions is also carried. When the boats were built the main armament comprised the pre-World War II Mk 8 anti-ship torpedo, the 1950s technology wire-guided Mk 23 ASW torpedo and World War II Mk 5 ground and Mk 6 moored mines. Since then the armament has been modernized to include the Mk 8, the Mk 24 Tigerfish wire-guided dual-role torpedo, the Sub-Harpoon anti-ship missile and the new Stonefish and Sea Urchin ground mines. It was the *Churchill* that tested the Sub-Harpoon for the Royal Navy. During the 1982 Falklands war the *Conqueror, Courageous* and *Valiant* were deployed to the Maritime Exclusion Zone, the first sinking the Argentinian cruiser *General Belgrano* on 2 May 1982. All five vessels are due to remain in service until the mid- to late-1990s, and are increasingly being employed in the anti-surface ship role as quieter boats enter service.

Specification

'Valiant' and 'Churchill' classes

Displacement: 4,400 tons surfaced and 4,900 tons dived
Dimensions: length 86.9 m (285 ft 0 in); beam 10.1 m (33 ft 3 in); draught 8.2 m (27 ft 0 in)
Machinery: one pressurized-water reactor powering two steam turbines driving one shaft
Speed: 20 kts surfaced and 29 kts dived
Diving depth: 300 m (985 ft) operational and 500 m (1,640 ft) maximum
Torpedo tubes: six 533-mm (21-in) bow
Basic load: a mix of 32 Mk 8 and Mk 24 Tigerfish 533-mm (21-in) torpedoes or 64 Mk 5 Stonefish and Mk 6 Sea Urchin mines; this is being changed to 26 533-mm (21-in) torpedoes and six Sub-Harpoon anti-ship missiles
Missiles: none
Electronics: one Type 1006 surface-search radar, one Type 2001 sonar, one Type 2024 towed sonar, one Type 2007 sonar, one Type 2019 sonar, one Type 197 sonar, one direction-finding antenna, one ESM system, one DCB torpedo fire-control system, and one underwater telephone
Complement: 103

Essentially an enlarged version of the 'Dreadnought' design, HMS Valiant *was built at the same time as the Polaris boats with an all-British PWR1 reactor plant and associated control systems.*



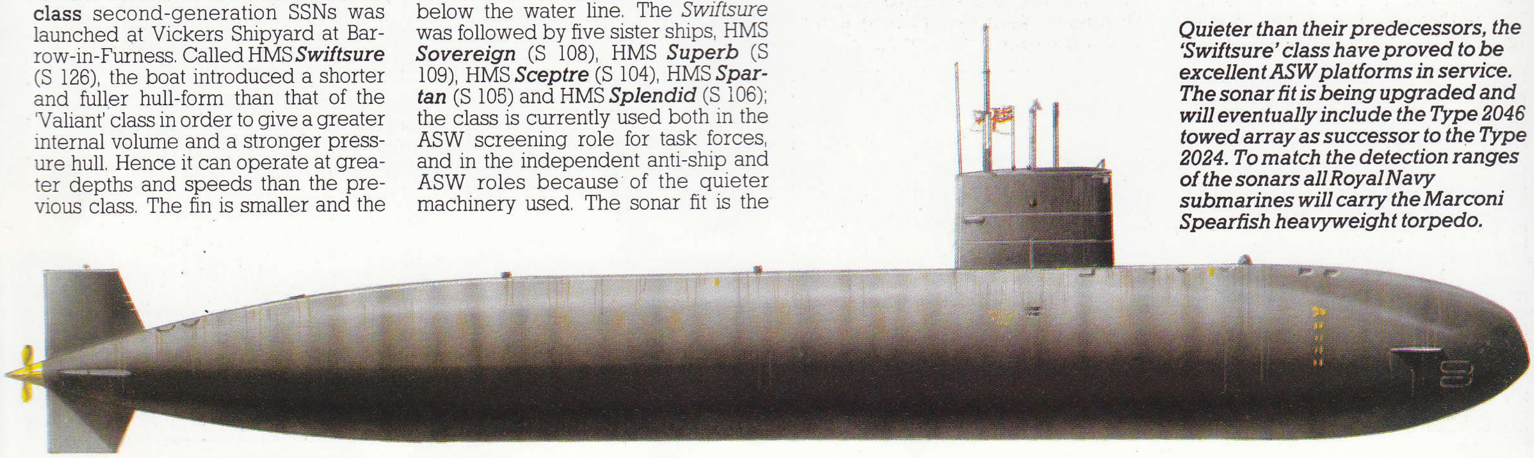
Below: Destined to remain in service until the mid to late 1990s, the five 'Valiant' and 'Churchill' class vessels are undergoing modernization refits as they come in for overhauls.

UK

'Swiftsure' class SSN

In 1971 the first of the UK's **'Swiftsure' class** second-generation SSNs was launched at Vickers Shipyard at Barrow-in-Furness. Called HMS ***Swiftsure*** (S 126), the boat introduced a shorter and fuller hull-form than that of the 'Valiant' class in order to give a greater internal volume and a stronger pressure hull. Hence it can operate at greater depths and speeds than the previous class. The fin is smaller and the retractable diving planes are located below the water line. The *Swiftsure* was followed by five sister ships, HMS ***Sovereign*** (S 108), HMS ***Superb*** (S 109), HMS ***Sceptre*** (S 104), HMS ***Spartan*** (S 105) and HMS ***Splendid*** (S 106); the class is currently used both in the ASW screening role for task forces, and in the independent anti-ship and ASW roles because of the quieter machinery used. The sonar fit is the

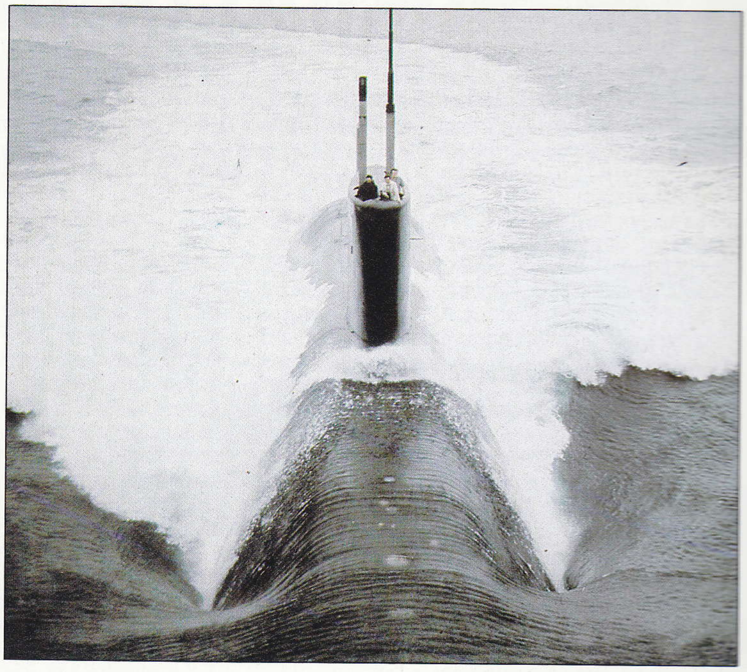
Quieter than their predecessors, the 'Swiftsure' class have proved to be excellent ASW platforms in service. The sonar fit is being upgraded and will eventually include the Type 2046 towed array as successor to the Type 2024. To match the detection ranges of the sonars all Royal Navy submarines will carry the Marconi Spearfish heavyweight torpedo.



same as in the 'Valiant' class, but all will have the Type 2020 fitted as the Type 2001 replacement during normal refits. The armament is reduced by one tube and seven torpedoes, but this reduction is balanced by the fact that it takes only 15 seconds to reload individual tubes. Emergency power is provided by the same 112-cell electric battery and associated diesel generator and electric motor as fitted in the 'Valiant' and 'Churchill' classes. In 1976 the *Sovereign* demonstrated the Royal Navy's ability to conduct ASW operations under the ice pack when she undertook a trip to the North Pole, the operational aspects being combined with a successful scientific voyage. The *Spartan* and *Splendid* were both involved in the Falklands war.

Specification

'Swiftsure' class
Displacement: 4,200 tons surfaced and 4,500 tons dived
Dimensions: length 82.9 m (272 ft 0 in); beam 9.8 m (32 ft 3 in); draught 8.2 m (27 ft 0 in)
Machinery: one pressurized-water reactor powering two steam turbines driving one shaft
Speed: 20 kts surfaced and 30 kts dived
Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum
Torpedo tubes: five 533-mm (21-in) bow
Basic load: 20 Mk 8 or Mk 24 Tigerfish 533-mm (21-in) torpedoes plus five Sub-Harpoon anti-ship missiles, or 50 Mk 5 Stonefish and Mk 6 Sea Urchin mines
Missiles: none
Electronics: one Type 1006 surface-search radar, one Type 2001 sonar, one Type 2024 towed sonar, one Type 2007 sonar, one Type 2019 sonar, one Type 197 sonar, one ESM system, one DCB torpedo and missile fire-control system, and one underwater telephone
Complement: 97



To improve underwater performance, HMS* Swiftsure *was introduced into service with a shorter and fuller hull form. This gives greater internal volume and a stronger pressure hull than earlier boats.

UK

'Trafalgar' class SSN

Essentially an improved 'Swiftsure' design, the **'Trafalgar' class** constitutes the third generation of British SSNs to be built at Vickers Shipyard in Barrow-in-Furness. The lead boat, HMS *Trafalgar* (S 107), was launched in 1981 and commissioned into the Royal Navy in March 1983, serving with the 'Swiftsure' class boats at the Devonport naval base. A class total of at least six is expected with five (HMS *Turbulent*, HMS *Talent*, HMS *Tactician*, HMS *Tireless* and HMS *Torbay*) already on order. The major improvements over the 'Swiftsure' class include several features to reduce the underwater radiated noise. These comprise a new reactor system, a pump-jet propulsion system rather than a conventional propeller and the covering of the pressure hull and outer surfaces with anechoic tiles to give the same type of protection as afforded by the Soviet 'Clusterguard' coating in reducing noise. The *Trafalgar* is the first boat to be fitted with the Type 2020 sonar, and is being used as the development test platform for the system. According to other reports there has also been an internal compartment rearrangement to rationalize and centralize the operations, sound and ESM/radar rooms. The remaining systems, the armament and the sonars are the same as fitted to the 'Swiftsure' class boats, although a thermal imagery periscope is now carried as part of the search and attack periscope fit, and Type 197 sonar is no longer carried. The fin, like those of the earlier British SSN classes, also houses an SHF DF antenna, several communications antennae, a snort induction mast, radar masts and ESM masts. Underwater communications are believed to be conducted via a towed buoy and/or a floating antenna. The primary mission of the 'Trafalgar' class boats is ASW, with a secondary anti-ship role.

Specification

'Trafalgar' class
Displacement: 4,700 tons surfaced and 5,200 tons dived
Dimensions: length 85.4 m (280 ft 3 in); beam 9.8 m (32 ft 3 in); draught 8.2 m (27 ft 0 in)
Machinery: one pressurized-water reactor powering two steam turbines driving one shaft with pump-jet propulsion
Speed: 20 kts surfaced and 29 kts dived
Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum
Torpedo tubes: five 533-mm (21-in) bow
Basic load: 20 Mk 8 and Mk 24 Tigerfish 533-mm (21-in) torpedoes and five Sub-Harpoon anti-ship missiles, or 50 Mk 5 Stonefish and Mk 6 Sea Urchin mines
Missiles: none
Electronics: one Type 1006 surface-search radar, one Type 2020 sonar, one Type 2024 towed sonar, one Type 2007 sonar, one Type 2019 sonar, one ESM system, and one DCB torpedo and missile fire-control system
Complement: 97

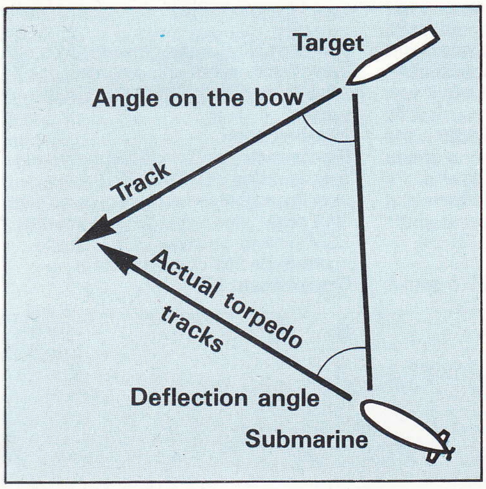
Right: Similar in many respects to the 'Swiftsure' class, HMS* Trafalgar *is the first Royal Navy submarine to be covered with anechoic tiles that reduced underwater radiated noise.

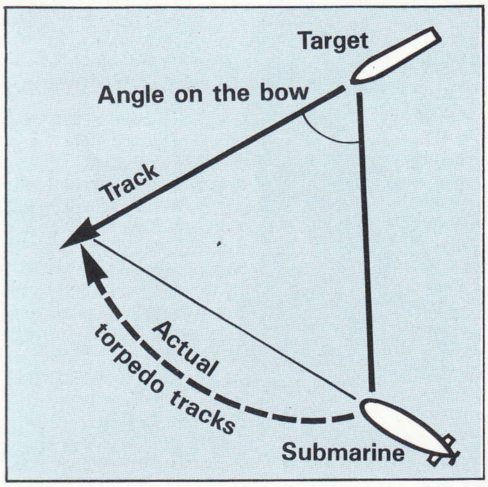
Below: With HMS* Illustrious *in the background, HMS* Trafalgar *enters Devonport Naval Base to tie up at the 2nd Submarine Squadron berth.

The Sinking of the *Belgrano*

The 1982 Falklands conflict saw the first use of nuclear submarines in combat. Five Royal Navy Fleet Submarines, designated Task Force 324 and under the direct command of Flag Officer Submarines Northwood, deployed to the Maritime Exclusion Zone and its immediate vicinity to protect the Carrier Task Force 37.

During the Falklands war of 1982 the UK deployed five of its fleet attack submarines (HMS *Conqueror, Courageous, Spartan, Splendid* and *Valiant*) to the South Atlantic. Acting under direct orders from Flag Officer Submarines at CinC Fleet Northwood, the fleet submarines were to protect the Task Force from the Argentinian submarine force, and to find and to monitor the movements of the Argentinian surface fleet's major units with a view to attacking them if they became a threat to the British force. By 26 April HMS *Conqueror* was patrolling an area south west of the Falklands just outside the declared Exclusion Zone whilst to her north was the 'Swiftsure' class boat *Splendid*. A second 'Swiftsure', HMS *Spartan*, was operating within the zone in ASW sweeps against potential Argentinian submarine activity.





By estimating the speed and course of the target, the submarine calculates the angle at which to fire its torpedoes. To confuse any ASW forces, the torpedoes may be fired in an arc to reach the calculated point at a deceptive angle.

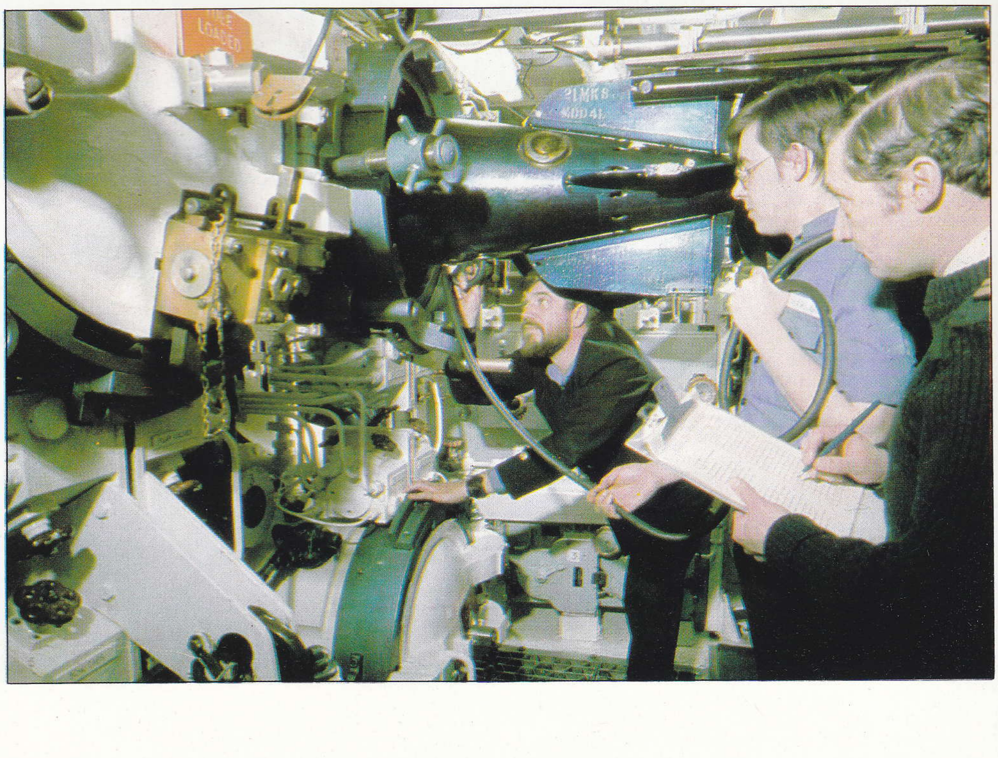
In the meantime the Argentinians had sailed the bulk of their fleet, designated Task Force 79, on 17 April; on 29 April it divided into two groups to cover the Falklands and to prepare for an attack on the British fleet. It was during the manoeuvres before the fleet split that the *Splendid* flashed a contact report to Northwood on a positive sighting of the two Type 42 destroyers and four smaller frigates and destroyers moving southwards near the mainland coast at 10 kts. Northwood confirmed the signal and ordered the *Splendid* to shadow the group. Twenty-four hours later the *Splendid* was again signalled, this time to break contact and proceed northwards to hunt for the elusive Argentinian carrier *Veinticinco de Mayo*.

The irony of the order is that had the *Splendid* stayed with the group she would have found the carrier and been in a position to attack her during the abortive Argentinian attempt to launch an air strike against the British carriers several days later, for the group shadowed by the *Splendid* was closing the *Veinticinco de Mayo*, as these vessels were to become the carrier's close escort. The overall British concerns at that time were the whereabouts of the enemy's two main surface units, which posed the greatest threat to the Task Force, namely the carrier and the heavy cruiser *General Belgrano*. It was not until the afternoon of 1 May that the latter was found: sighted by the *Conqueror*, the *Belgrano* was on a patrol line between the Isla de los Estados off Tierra del Fuego and the Birdwood Bank with her two consorts (the Exocet-armed destroyers *Hipolito Bouchard* and *Piedra Buena*), outside the exclusion zone. The contact report was sent to Northwood via a secure satellite-communication link, and the *Conqueror* was ordered to shadow and await further instructions. Admiral Woodward was advised of the sighting by Admiral Fieldhouse, the Chief of the Naval Staff at Northwood, and a planning meeting was called to decide what was to be done. Once a decision had been reached, the Chief of the Defence Staff, Admiral Sir Terence Lewin, went to a War Cabinet meeting at Chequers on the morning of Sunday 2 May. At this he requested the necessary permission under the rules of engagement laid down for the *Conqueror* to engage and sink the cruiser, putting forward a very effective case for doing so while the *Belgrano* was actually outside the zone. After some discussion the Prime Minister gave her decision to allow the attack to be launched, and the necessary signal was sent before midday to the *Conqueror*.

The attack

In the meantime the skipper of the *Conqueror*, Commander Christopher Louis Wreford-Brown, had followed the *Belgrano* underwater using his boat's effective passive sonar arrays to establish the cruiser's and escorts' actual movements on a target and range plot set up in the operations room. Once the order to attack had been received the plot data of the ships, now heading towards Tierra del Fuego's southern tip on the westerly leg of the patrol line, was fed into the DCB torpedo fire-control system in order that a firing solution could be calculated for the principal target. The selected attack method was a salvo of pre-World War II-designed Mk 8** anti-ship torpedoes rather than the modern wire-guided Mk 24 Tigerfish model, the reason being that although the Mk 24 was longer ranged the Mk 8** could be fired in a spread of four (rather than two) in order to increase the chances of a

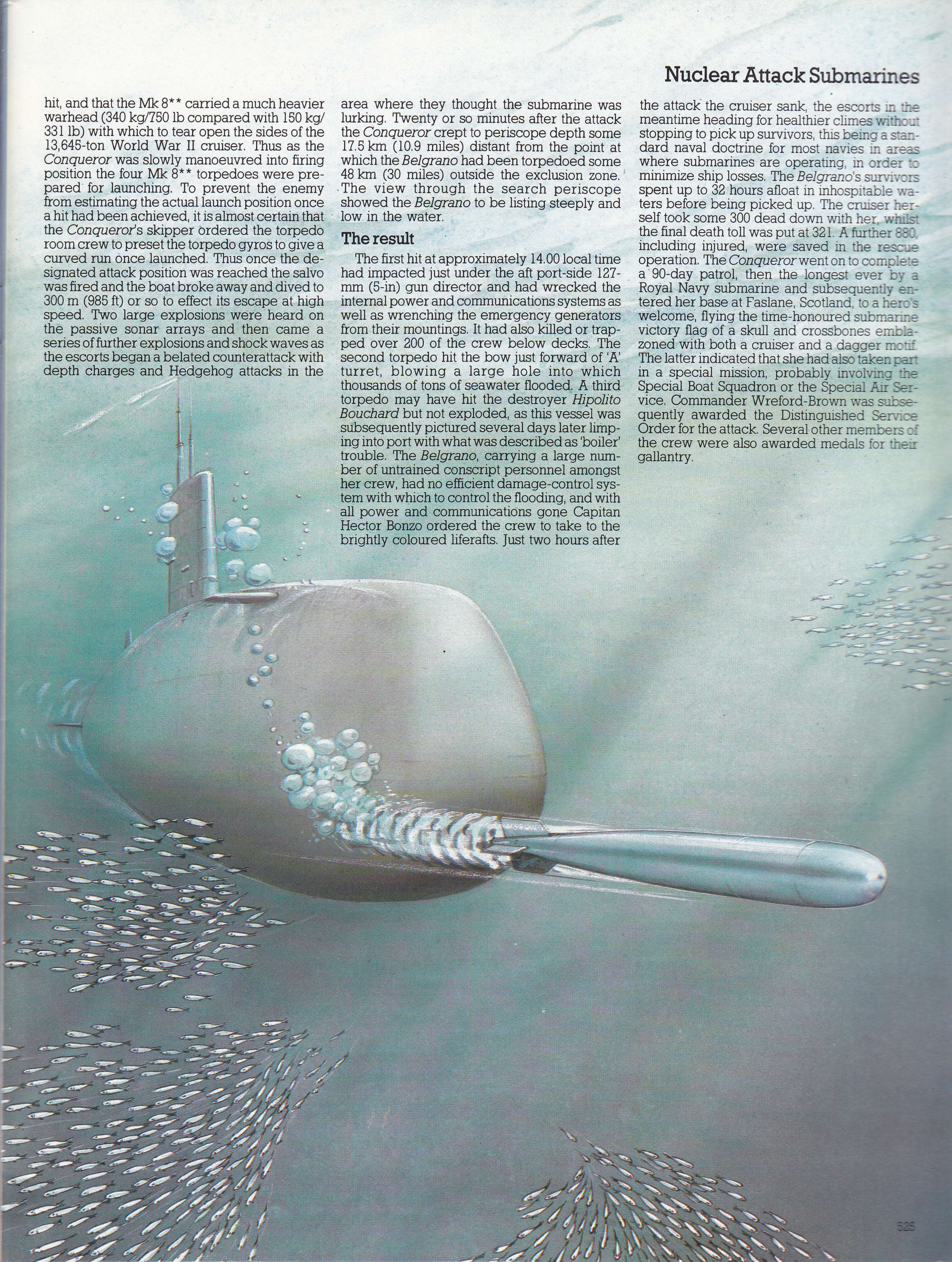
Below: A Mk 8 anti-ship torpedo is loaded into the bow tube of a Fleet submarine. The Mk 8 was chosen in preference to the Mk 24 Tigerfish because it had a heavier warhead, and more could be fired in a salvo.



hit, and that the Mk 8** carried a much heavier warhead (340 kg/750 lb compared with 150 kg/331 lb) with which to tear open the sides of the 13,645-ton World War II cruiser. Thus as the *Conqueror* was slowly manoeuvred into firing position the four Mk 8** torpedoes were prepared for launching. To prevent the enemy from estimating the actual launch position once a hit had been achieved, it is almost certain that the *Conqueror*'s skipper ordered the torpedo room crew to preset the torpedo gyros to give a curved run once launched. Thus once the designated attack position was reached the salvo was fired and the boat broke away and dived to 300 m (985 ft) or so to effect its escape at high speed. Two large explosions were heard on the passive sonar arrays and then came a series of further explosions and shock waves as the escorts began a belated counterattack with depth charges and Hedgehog attacks in the area where they thought the submarine was lurking. Twenty or so minutes after the attack the *Conqueror* crept to periscope depth some 17.5 km (10.9 miles) distant from the point at which the *Belgrano* had been torpedoed some 48 km (30 miles) outside the exclusion zone. The view through the search periscope showed the *Belgrano* to be listing steeply and low in the water.

The result

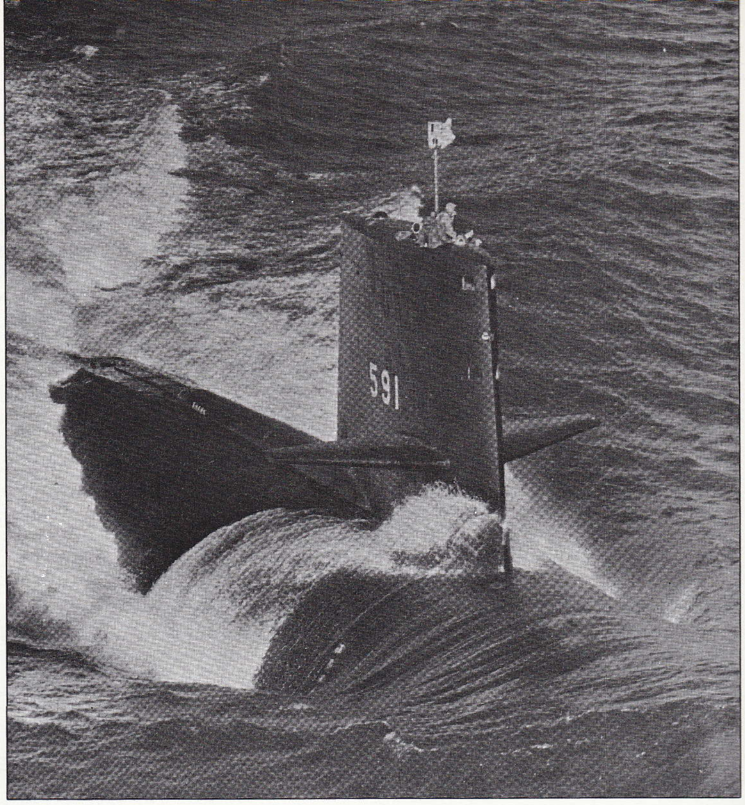
The first hit at approximately 14.00 local time had impacted just under the aft port-side 127-mm (5-in) gun director and had wrecked the internal power and communications systems as well as wrenching the emergency generators from their mountings. It had also killed or trapped over 200 of the crew below decks. The second torpedo hit the bow just forward of 'A' turret, blowing a large hole into which thousands of tons of seawater flooded. A third torpedo may have hit the destroyer *Hipolito Bouchard* but not exploded, as this vessel was subsequently pictured several days later limping into port with what was described as 'boiler' trouble. The *Belgrano*, carrying a large number of untrained conscript personnel amongst her crew, had no efficient damage-control system with which to control the flooding, and with all power and communications gone Capitan Hector Bonzo ordered the crew to take to the brightly coloured liferafts. Just two hours after the attack the cruiser sank, the escorts in the meantime heading for healthier climes without stopping to pick up survivors, this being a standard naval doctrine for most navies in areas where submarines are operating, in order to minimize ship losses. The *Belgrano*'s survivors spent up to 32 hours afloat in inhospitable waters before being picked up. The cruiser herself took some 300 dead down with her, whilst the final death toll was put at 321. A further 880, including injured, were saved in the rescue operation. The *Conqueror* went on to complete a 90-day patrol, then the longest ever by a Royal Navy submarine and subsequently entered her base at Faslane, Scotland, to a hero's welcome, flying the time-honoured submarine victory flag of a skull and crossbones emblazoned with both a cruiser and a dagger motif. The latter indicated that she had also taken part in a special mission, probably involving the Special Boat Squadron or the Special Air Service. Commander Wreford-Brown was subsequently awarded the Distinguished Service Order for the attack. Several other members of the crew were also awarded medals for their gallantry.



USA

'Skipjack' class SSN

Although built in the late 1950s, the five **'Skipjack' class** boats currently in service are still considered to be front-line operational boats and were, until the advent of the 'Los Angeles' class, the fastest submarines available to the US Navy. A sixth boat, the USS ***Scorpion*** (SSN 589, whose original hull was used in the construction of the first American SSBN, the USS *George Washington*), was lost in May 1968 south west of the Azores whilst en route from the Mediterranean to Norfolk, Virginia, with all 99 men aboard. The class is notable for being the first to use the S5W reactor design, which was subsequently used in all nuclear submarine classes built in the United States up to the 'Glenard P. Lipscomb' class. The 'Skipjack' class also introduced the classic teardrop hull shape, and as such acted as the model for the British 'Dreadnought' and 'Valiant/Churchill' classes, the long rearward taper of the hull forcing the designers to dispense with stern torpedo tubes and adopt a single-shaft propulsion arrangement. The diving planes were also relocated to the fin to increase underwater manoeuvrability, a feature which the British did not copy. All the engine room fittings except the reactor and steam turbines are duplicated to minimize breakdown possibilities. At present four boats (USS ***Skipjack***, USS ***Scamp***, USS ***Sculpin*** and USS ***Shark***) serve in the Atlantic Fleet and one (USS ***Snook***) in the Pacific Fleet. However, as a result of their age the 'Skipjack' class boats might well be relegated as training craft and high-speed underwater ASW targets in place of the old SSBNs now being used in that role.



USS* Shark *at its maximum surface speed of 18 kts. With an underwater speed of 30 kts, the five remaining 'Skipjack' class vessels are still considered to be front-line submarines.

Specification

'Skipjack' class

Displacement: 3,075 tons surfaced and 3,515 tons dived

Dimensions: length 76.7 m (251 ft 9 in); beam 9.6 m (31 ft 6 in); draught 8.5 m (27 ft 10 in)

Machinery: one Westinghouse S5W pressurized-water reactor powering two steam turbines driving one shaft

Speed: 18 kts surfaced and 30 kts dived

Diving depth: 300 m (985 ft) operational and 500 m (1,640 ft) maximum

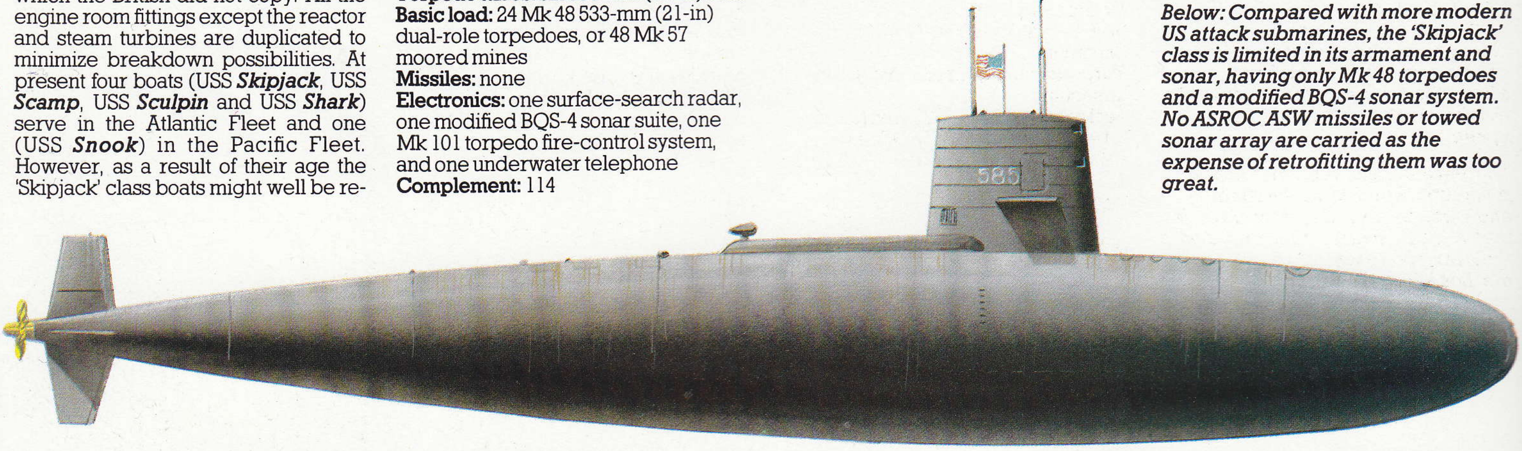
Torpedo tubes: six 533-mm (21-in) bow

Basic load: 24 Mk 48 533-mm (21-in) dual-role torpedoes, or 48 Mk 57 moored mines

Missiles: none

Electronics: one surface-search radar, one modified BQS-4 sonar suite, one Mk 101 torpedo fire-control system, and one underwater telephone

Complement: 114

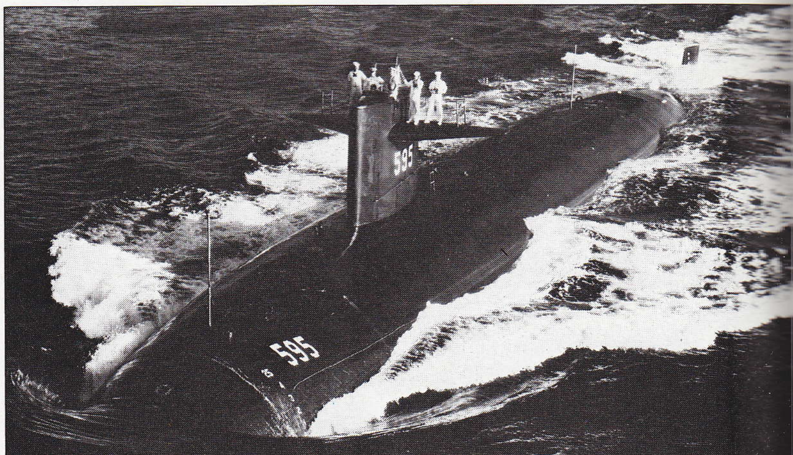


Below: Compared with more modern US attack submarines, the 'Skipjack' class is limited in its armament and sonar, having only Mk 48 torpedoes and a modified BQS-4 sonar system. No ASROC ASW missiles or towed sonar array are carried as the expense of retrofitting them was too great.

USA

'Thresher' class (later 'Permit' class) SSN

The first of the SSNs in the US Navy with a deep-diving capability, advanced sonars mounted in the optimum bow position, amidships angled torpedo tubes with the SUBROC ASW missile, and a high degree of machinery-quieting, the **'Thresher' class** is still an important part of US attack capability. The lead boat of this class, the USS ***Thresher*** (SSN 593), was lost with all 129 people on board during diving trials off the coast of New England on 10 April 1963, mid-way through the building period 1960-6. The class was then renamed the **'Permit' class** after the second ship. As a result of the lessons learnt from the enquiry following the *Thresher*'s loss, the last three of the class were modified during construction with SUBSAFE features, heavier machinery and taller sail structures, essentially to act as the prototypes for the follow-on 'Sturgeon' class. In addition USS ***Jack*** (SSN 605) was built to a different design with two propellers on one shaft and a contra-rotating turbine without reduction gear to test a new method of reducing machinery-operating noises. This was unsuccessful, however, and the vessel was refitted with standard machinery. During the normal refit programme the original Mk 113 torpedo fire-control system and the BQQ-2 sonar suite are to be replaced with the all digital Mk 117 FCS and the BQQ-5 sonar suite with clip-on towed sonar array facilities. All will also be fitted to carry and fire the Sub-Harpoon and Tomahawk missiles. The SUBROC will be replaced by a new stand-off ASW missile in the late 1980s, with the choice of either a nuclear depth bomb or an ASW torpedo as the payload. At present eight 'Permit' class boats (USS ***Permit***, USS ***Plunger***, USS ***Barb***, USS ***Pollack***, USS ***Haddo***, USS ***Guardfish***, USS ***Flasher*** and USS ***Haddock***) serve in the Pacific and five (USS ***Jack***, USS ***Tinosa***, USS ***Dace***, USS ***Greenling*** and USS ***Gato***) in the Atlantic.



Specification

'Permit' class

Displacement: 3,750 tons surfaced and 4,311 tons dived, except *Jack* 3,800 tons surfaced and 4,470 tons dived, and *Flasher, Greenling* and *Gato* 3,800 tons surfaced and 4,642 tons dived

Dimensions: length 84.9 m (278 ft 6 in) except *Jack* 85.9 m (297 ft 5 in) and *Flasher, Greenling* and *Gato* 89.1 m (292 ft 3 in); beam 9.6 m (31 ft 8 in); draught 8.8 m (28 ft 10 in)

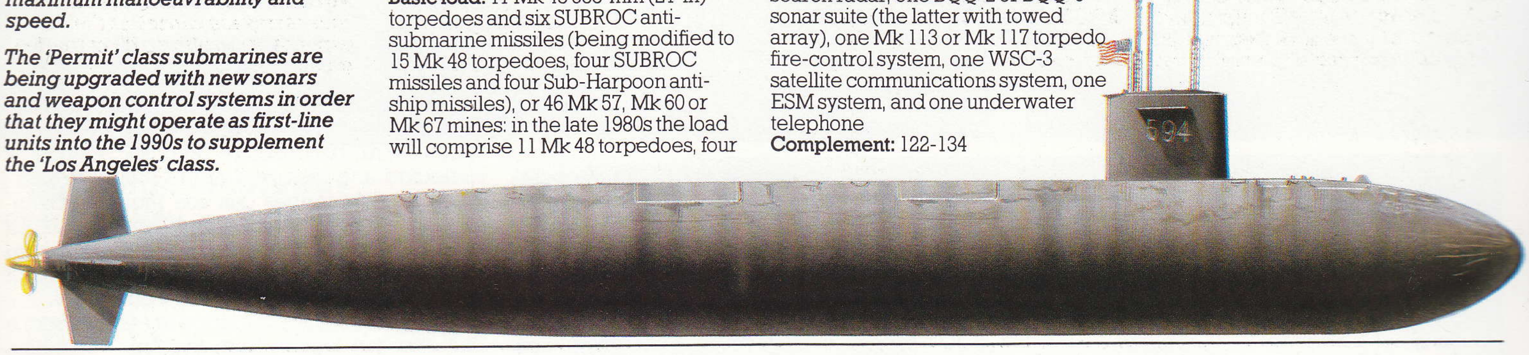
Machinery: one Westinghouse S5W pressurized-water reactor powered two steam turbines driving one shaft

Speed: 18 kts surface and 27 kts dived, except *Jack, Flasher, Greenling* and *Gato* 18 kts surfaced and 26 kts dived

The first US Navy SSN class with a deep diving capability, advanced sonars, amidships torpedo tubes, and machinery quieting systems was the 'Permit' class. USS* Plunger *is seen here off the coast of Hawaii during her first fleet deployment in 1963.

USS** Barb **executes a high speed turn on the surface. Underwater, the submarine would be 'flown' using controls similar to those found aboard aircraft in order to exploit its maximum manoeuvrability and speed.

Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum
Torpedo tubes: four 533-mm (21-in) amidships
Basic load: 17 Mk 48 533-mm (21-in) torpedoes and six SUBROC anti-submarine missiles (being modified to 15 Mk 48 torpedoes, four SUBROC missiles and four Sub-Harpoon anti-ship missiles), or 46 Mk 57, Mk 60 or Mk 67 mines: in the late 1980s the load will comprise 11 Mk 48 torpedoes, four Sub-Harpoon missiles, four Tomahawk cruise missiles and four ASWSOW weapons.
Missiles: none, but see above
Electronics: one BPS-11 surface-search radar, one BQQ-2 or BQQ-5 sonar suite (the latter with towed array), one Mk 113 or Mk 117 torpedo fire-control system, one WSC-3 satellite communications system, one ESM system, and one underwater telephone
Complement: 122-134



The 'Permit' class submarines are being upgraded with new sonars and weapon control systems in order that they might operate as first-line units into the 1990s to supplement the 'Los Angeles' class.

USA

'Sturgeon' class SSN

Essentially an enlarged and improved 'Thresher/Permit' design with additional quieting features and electronic systems, the **'Sturgeon' class** SSNs built between 1965 and 1974 were the largest class of nuclear-powered warships built anywhere until the advent of the 'Los Angeles' class boats. Like the previous class they are intended primarily for ASW, and employ the standard American SSN amidships torpedo battery aft of the fin, with two tubes firing diagonally outwards from the hull on each side. This allows a larger torpedo handling room than in bow-battery boats, and facilitates fast access, weapon choice and reloading of the tubes. The last nine of the class were lengthened to accommodate more electronic equipment. What is not widely known, however, is that these are the boats used in one of the most closely guarded and classified naval intelligence programmes currently in operation. Codenamed 'Holy Stone', the programme was initiated in the late 1960s and involves the use of these submarines in highly specialized intelligence-gathering missions close to the coasts of nations unfriendly towards the United States. The additional intelligence-gathering equipment is located in special compartments and is operated by National Security Agency personnel specifically carried for the task. During these operations several collisions with other underwater and surface craft have occurred, resulting sometimes in damage to the US boats involved; and on one occasion at least a 'Holy Stone' submarine was accidentally grounded for several hours during a mission within the territorial waters of the Soviet Far East. As in the case of the 'Thresher/Permit' class, the boats are being retrofitted with the Mk 117 FCS and BQQ-5 sonar suite, and will carry both the Sub-Harpoon and Tomahawk. At present 22 (including five 'Holy Stone' vessels serve in the Atlantic and 15 (including the remaining four 'Holy Stone' vessels) in the Pacific. The USS ***Hawkbill***, USS ***Pintado*** and several others have also been converted to carry a DSRV (deep-submergence rescue vehicle) aft for launch and recovery underwater during SUBSMASH rescue operations.

Of the 22 'Sturgeon' class SSNs operational with the Atlantic Fleet, it is thought that the 'standard' boats are the USS ***Sturgeon***, USS ***Whale***, USS ***Grayling***, USS ***Sunfish***, USS ***Pargo***, USS ***Ray***, USS ***Lapon***, USS ***Hammerhead***, USS ***Sea Devil***, USS ***Bergall***, USS ***Spadefish***, USS ***Seahorse***, USS ***Finback***, USS ***Flying Fish***, USS ***Trepang***, USS ***Bluefish*** and USS ***Billfish***, while the 'Holy Stone' boats are probably the USS ***Archerfish***, USS ***Silversides***, USS ***Batfish***, USS ***L. Mendel Rivers*** and USS ***Richard B. Russell***. The Pacific Fleet's 15 'Sturgeon' class boats are the 'standard' USS ***Tautog***, USS ***Pogy***, USS ***Aspro***, USS ***Queenfish***, USS ***Puffer***, USS ***Sand Lance***, USS ***Gurnard***, USS ***Guitarro***, USS ***Hawkbill***, USS ***Pintado*** and USS ***Drum***, and the 'Holy Stone' USS ***William H. Bates***, USS ***Tunny***, USS ***Parche*** and USS ***Cavalla.***

Specification

'Sturgeon' class
Displacement: 4,266 tons surfaced and 4,777 tons dived
Dimensions: length 89.0 m (292 ft 3 in) except *Archerfish, Silversides, William H. Bates, Batfish, Tunny, Parche, Cavalla, L. Mendel Rivers* and *Richard B. Russell* 92.1 m (302 ft 2 in); beam 9.65 m (31 ft 8 in); draught 8.9 m (29 ft 3 in)
Machinery: one Westinghouse S5W pressurized-water reactor powered two steam turbines driving one shaft
Speed: 18 kts surfaced and 26 kts dived
Diving depth: 400 m (1,315 ft) operation and 600 m (1,970 ft) maximum
Torpedo tubes: four 533-mm (21-in) amidships
Basic load: 17 Mk 48 533-mm (21-in) torpedoes and six SUBROC anti-submarine missiles (being modified to 15 Mk 48 torpedoes, four SUBROC missiles and four Sub-Harpoon anti-ship missiles), or 46 Mk 57, Mk 60 or Mk 67 mines; in the late 1980s the load will comprise 11 Mk 48 torpedoes, four Sub-Harpoon missiles, four Tomahawk cruise missiles and four ASWSOW weapons
Missiles: none, but see above
Electronics: one BPS-15 surface-search radar, one BQQ-2 or BQQ-5 sonar suite (the latter with towed array), one Mk 113 or Mk 117 torpedo fire-control system, one ESM suite, one WSC-3 satellite communication system, and one underwater telephone
Complement: 121-134

Sturgeon Class Submarines in Action

In the shadowy intelligence struggle taking place beneath the surface of the Atlantic all the year round, the American attack submarine provides the major tactical underwater component of NATO's naval commands. Once war is declared, then it would be vessels like USS* Sturgeon *that would have to penetrate heavily-defended Soviet navy sanctuaries in order to detect and destroy the Soviet SSBN fleet.

You are in a very large, dark room. It is silent, but you are aware of someone's presence and you know that he is looking for you. You would like to know where he is but to move causes a rustling on the threadbare carpet and entails a risk of betraying your position by contacting furniture which may, or may not, be there. You strain your ears, knowing that he is doing the same. To add spice to the game, you carry a loaded gun, knowing that he, too, has one and will use it if he can find you.

This may be most people's idea of a nightmare, but it is also a fairly close analogy of the everyday world of the submariner. It is a blind, predatory world where to be silent is to succeed and to survive.

The game is played by boats such as the nuclear-powered USS *Sturgeon* (SSN 637), known as attack submarines in the USN and fleet submarines in the Royal Navy. The former term is probably better, for these are 'hot-war' weapons platforms. Surface warships can impress or intimidate visually; submarines only by implication. They cannot warn, for that would be to betray their presence. They can only kill.

Before the age of nuclear power, a boat needed to surface almost daily to recharge batteries and renew the air in the hull. While this facilitated communications and navigation, and served as a reminder of the real world, it was also the boat's greatest weakness, for she had cast off her greatest advantage, the cloak of invisibility. Nuclear power can regenerate onboard air for considerable periods and, with a hull optimized for submerged performance, the *Sturgeon* does not need to surface for the duration of her patrol. Her endurance is really that of her 107-strong crew, living in an artificial environment where day and night have no meaning. At 26 kts, her submerged speed is high because, unlike conventionally-powered boats, she is driven by steam turbines. Steam for these is raised by a boiler heated, via a heat exchanger, from the reactor. The water operates in a closed circuit to minimize loss.

In contrast with the sharply-tapered 'high-speed' hulls of earlier classes, the *Sturgeon* and her 36 sisters have a long, low freeboard over a parallel midbody that offers more internal volume. The external hull is smooth and featureless, with no unnecessary protuberances that could cavitate and cause noise. Her single, large-diameter propeller turns on a centreline shaft abaft the cruciform rudder and after hydroplane assembly. Her great speed is used sparingly, for to be fast is to be noisy.

For the greater part of a patrol, she will progress at 'loiter' speeds, not only to reduce the chances of her being detected but also to decrease the interference to her own sensors caused by water and hull noise.

At the present time, acoustics remain far and away the best basis for underwater sensing and, once submerged, a submarine relies heavily on her sonars. These can be passive, active or dual function. Active sets are not used indiscriminately, being equivalent to a beacon that advertises a boat's presence and so invites a homing weapon.

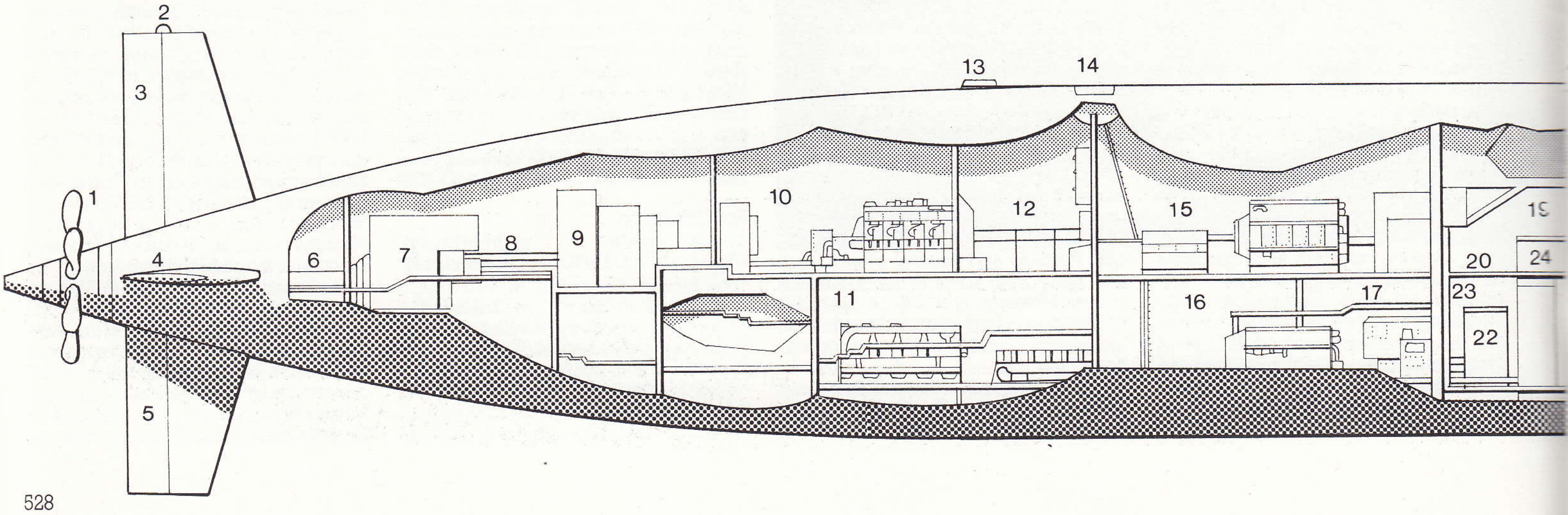
Torpedoes amidships

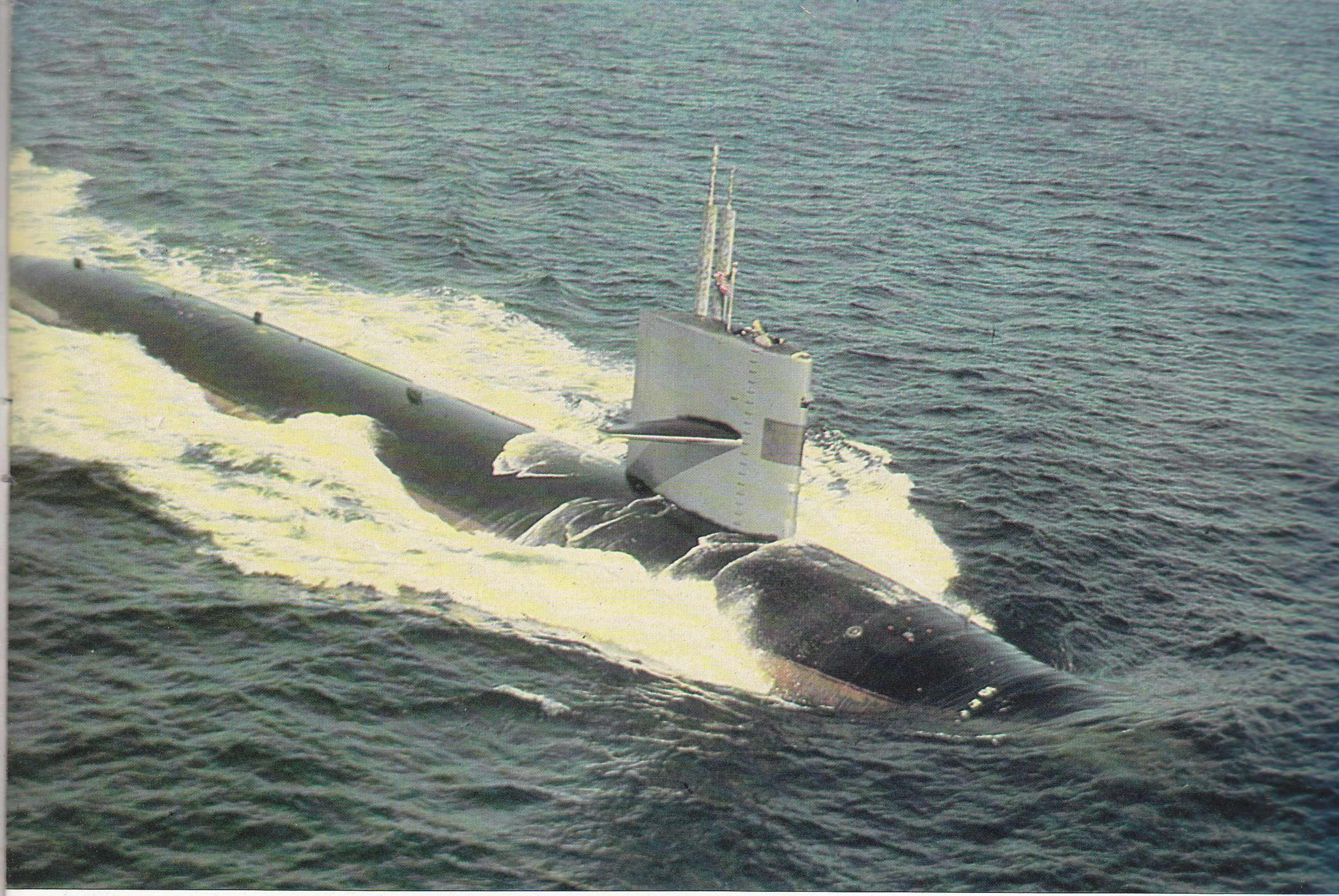
American designers take the view that the sonars are important enough to occupy prime siting. For this reason, the *Sturgeon*'s torpedo tubes are not right forward but amidships; this is less than ideal for the weapons department but releases the bow position for the enormous AN/BQS-6 sonar, an active set with the many individual transducers built into a 4.5-m (15-ft) diameter sphere. For surveillance purposes, an AN/BQR-7 passive sonar is used. By siting sensing elements along the length of the hull, it is possible to use the boat as a baseline to get a bearing on a noise source. Range is not so easy to establish. Two boats could get a passively-derived cross bearing but would alert a target by necessary communication, so a rapid burst of energy from the active set is probably risked.

The sea is rarely uniform in character, but stacked with layers of water showing varying temperature and salinity. Acoustic energy is deflected and distorted at the resultant interfaces, so submarines can use them to advantage as aviators of yesteryear used cloud for concealment. By releasing bathythermal buoys, the commander can get a good idea of the situation and manoeuvre accordingly.

The 'teeth' of the submarine are the weapons that she can launch from the four amidships tubes. Dependent upon target, these can be full-sized Mk 48 torpedoes with wire guidance, homing and considerable intelligence for use against submarine or surface targets out to a

Left: USS* Queenfish *(SSN681) at her maximum surface speed of 18 kts. During a patrol an SSN rarely surfaces or comes to periscope depth, preferring to remain deep, listening with its sonars.

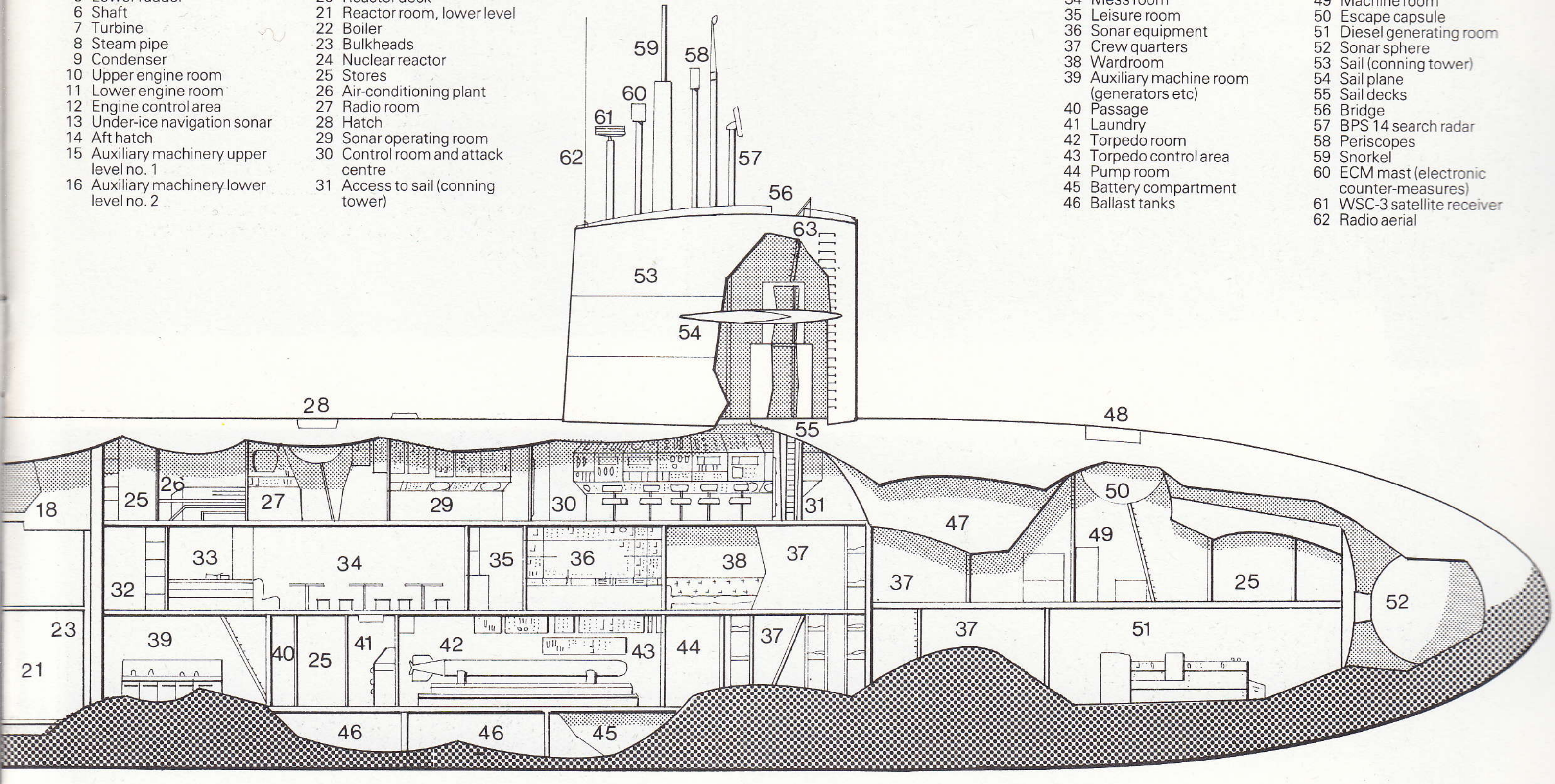


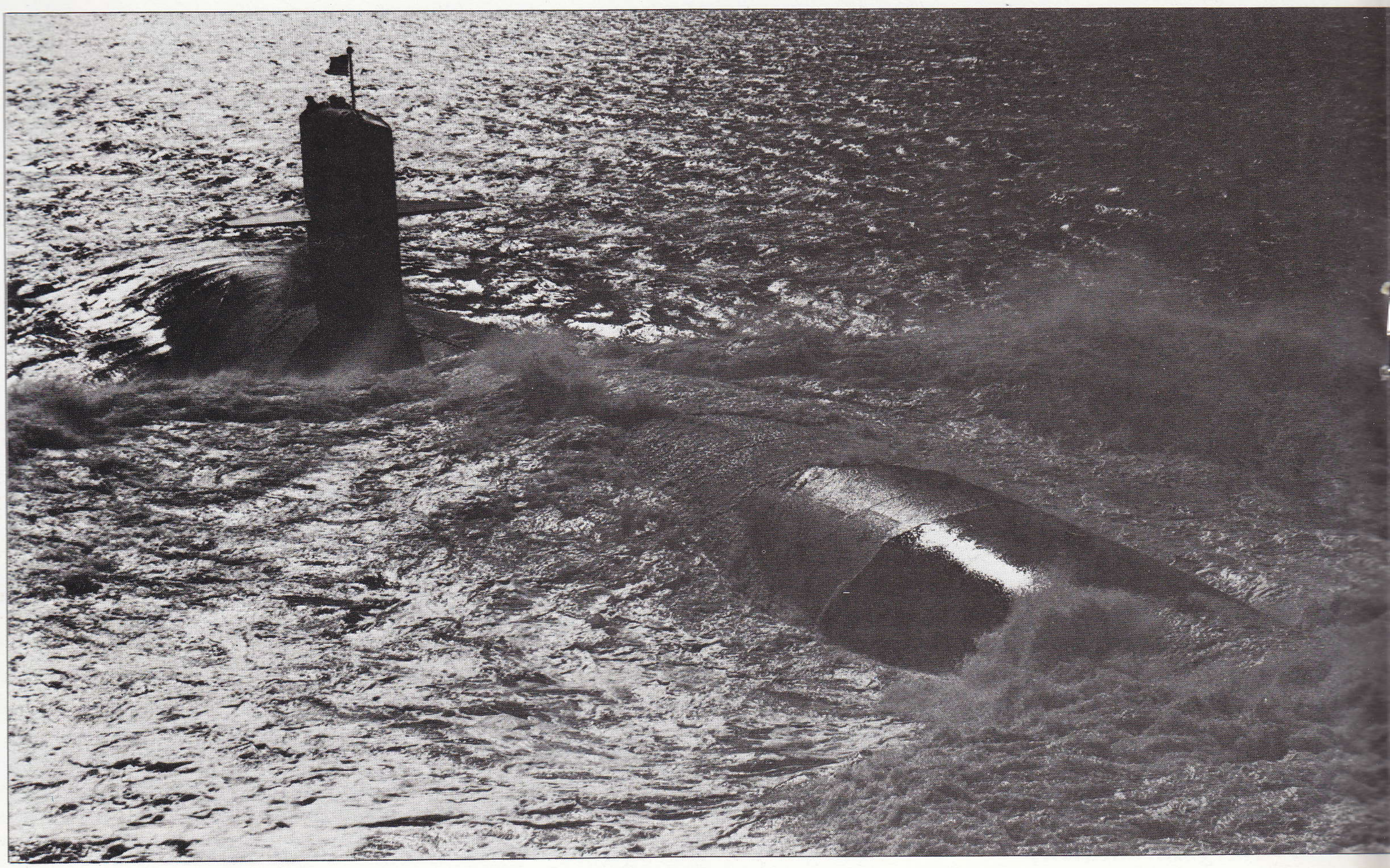


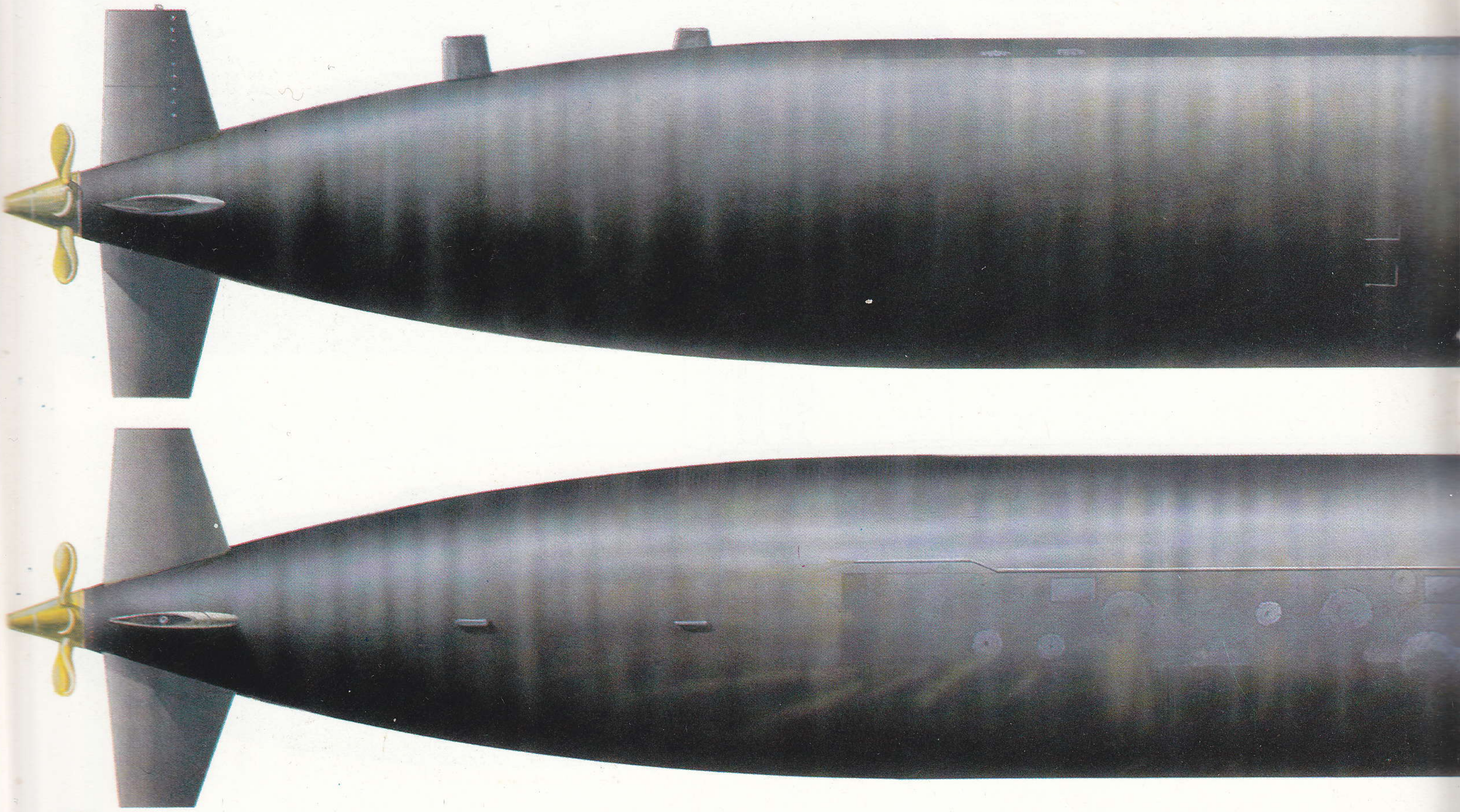
USS Silversides *(SSN679), one of the nine 'Holy Stone' special intelligence-gathering submarines in the US Navy that operate near to the coasts of countries unfriendly towards the USA.*

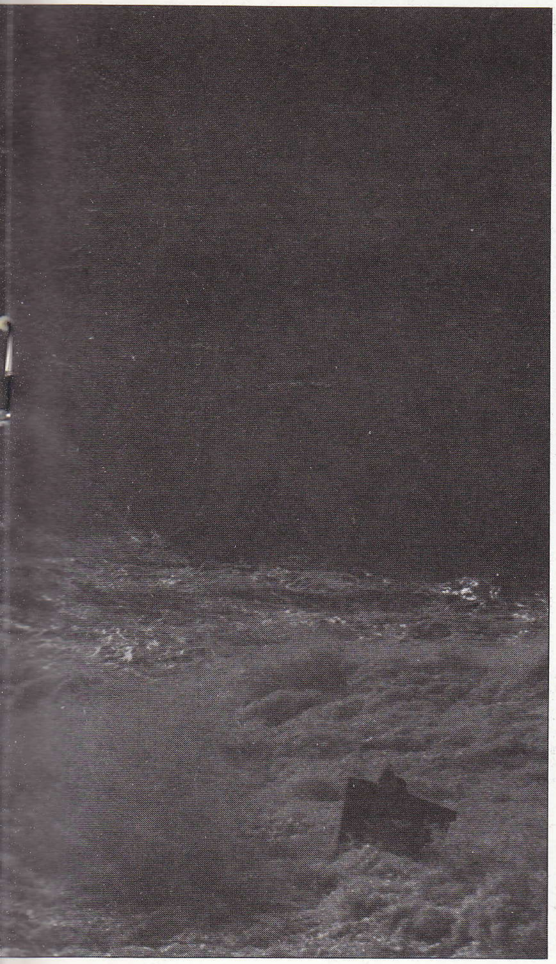
USS *Sturgeon* cutaway drawing key

1 Propeller
2 Navigation light
3 Upper rudder
4 Starboard diving plane
5 Lower rudder
6 Shaft
7 Turbine
8 Steam pipe
9 Condenser
10 Upper engine room
11 Lower engine room
12 Engine control area
13 Under-ice navigation sonar
14 Aft hatch
15 Auxiliary machinery upper level no. 1
16 Auxiliary machinery lower level no. 2
17 Auxiliary machinery lower level no. 3 (generators etc)
18 Tunnel through reactor area
19 Reactor room, upper level
20 Reactor deck
21 Reactor room, lower level
22 Boiler
23 Bulkheads
24 Nuclear reactor
25 Stores
26 Air-conditioning plant
27 Radio room
28 Hatch
29 Sonar operating room
30 Control room and attack centre
31 Access to sail (conning tower)
32 Frozen food store
33 Galley
34 Mess room
35 Leisure room
36 Sonar equipment
37 Crew quarters
38 Wardroom
39 Auxiliary machine room (generators etc)
40 Passage
41 Laundry
42 Torpedo room
43 Torpedo control area
44 Pump room
45 Battery compartment
46 Ballast tanks
47 Inner hull casing
48 Fore escape/access hatch
49 Machine room
50 Escape capsule
51 Diesel generating room
52 Sonar sphere
53 Sail (conning tower)
54 Sail plane
55 Sail decks
56 Bridge
57 BPS 14 search radar
58 Periscopes
59 Snorkel
60 ECM mast (electronic counter-measures)
61 WSC-3 satellite receiver
62 Radio aerial



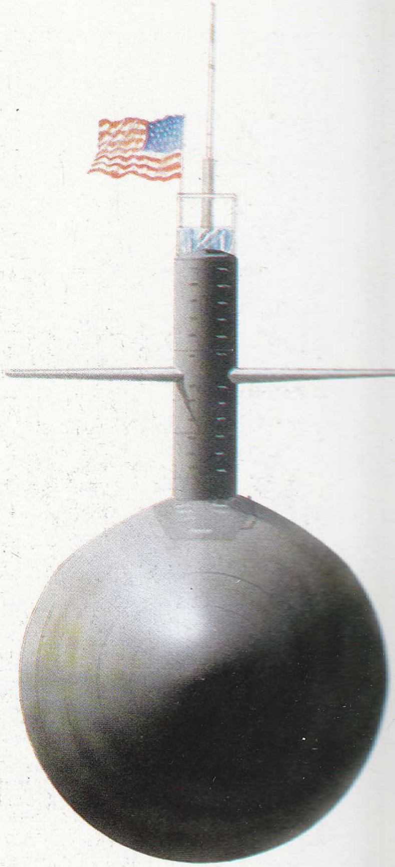


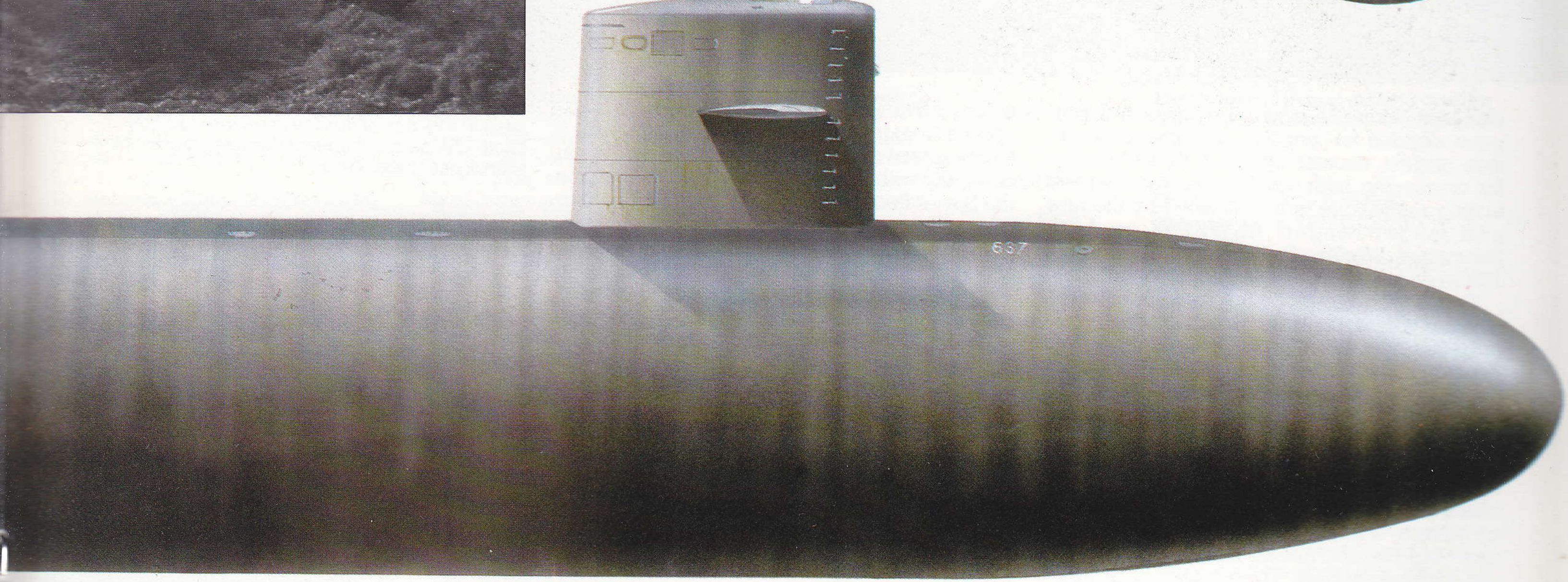


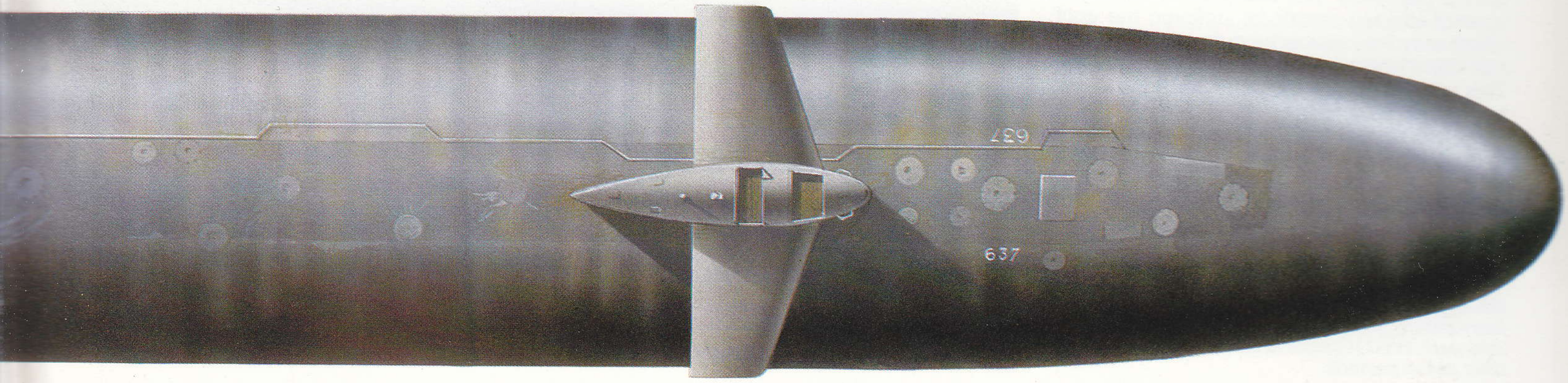


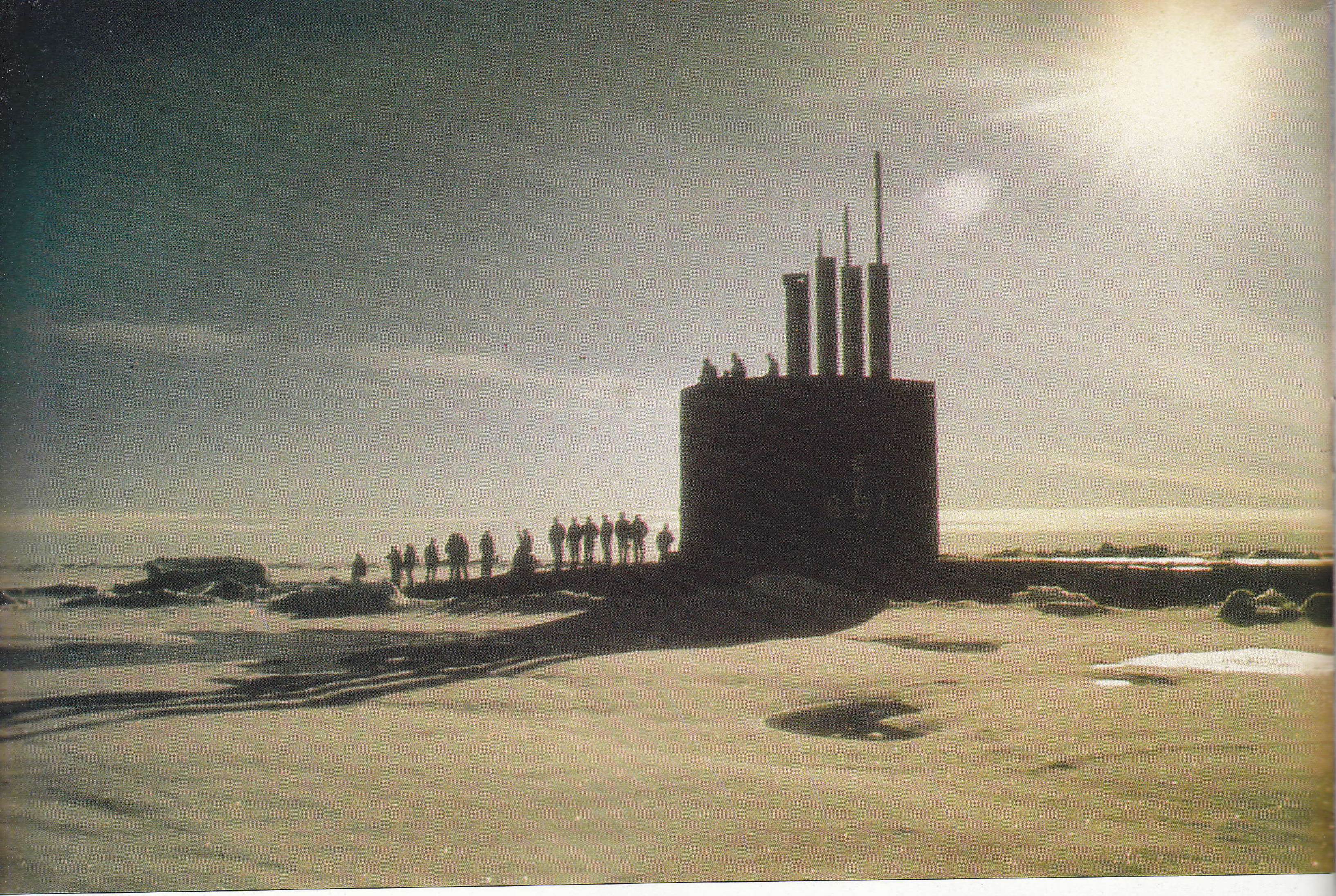
Left: USS Ray *(USSN653) carries a BQR-7 passive bow conformal sonar array (effective at 30-100 nm against a snorkling submarine, and 10-50 nm against a cavitating target), and a BQS-6 active spherical bow array that can operate in bottom-bounce and convergence-zone modes.*

Right and below: USS Sturgeon *(SSN637). The clean external lines have no unnecessary protuberances that could cause cavitation and hence radiated noise.* Sturgeon *is armed with the 10 kt yield SUBROC ASW missile and any orders to fire this weapon have to be cleared by the President of the USA, as it is considered to be a theatre tactical nuclear weapon.*









USS *Queenfish (SSN651) surfaces in the Arctic ice pack at a region of thin ice known as a polynya. Such ASW patrols beneath the ice-cap are vital to search out Soviet SSBNs.*

claimed 50 km (31 miles), encapsulated Harpoon missiles for 'pop-up' tactics against surface targets, nuclear-tipped SUBROC missile for countering high-value submerged targets at long range (due to be replaced by the new and longer-ranged ASWSOW or Anti-Submarine Warfare Stand-Off Weapon in the 1990s) or mines.

Coming shortly will be the Tomahawk cruise missile, whose potential against shore-based targets is such that its introduction could herald the beginning of the end for the current monstrous breeds of SSBN, each attack submarine assuming a measure of strategic capability.

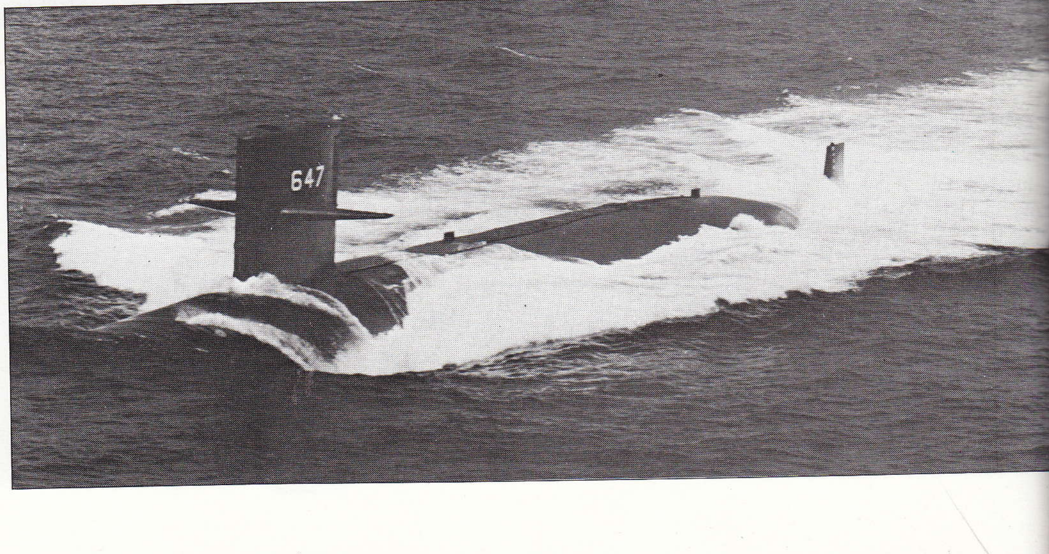
On-board weapons stowage being limited, it is important to arm the boat with a mix to suit her particular mission. Of these, the most hazardous would probably be the penetration of enemy 'citadel' zones where nuclear-powered ballistic-missile submarines (SSBNs) are held in readiness. These may include areas beneath the polar icecaps, where a lurking SSBN would use a thin patch, or polynya, for launch purposes. The *Sturgeon* is fitted with upward-looking sonars for defining the 'roof', which may well also extend downward to considerable depths, even reaching the seabed. This is no place for the half-hearted, the half-trained or the unwary.

Interdiction of SLOCs (Sea Lines Of Communication) would hardly be a requirement, for the Soviet Union and her bloc are virtually self-sufficient. In time of war, the USSR's technology-advanced merchant ships would disappear from trading and perform their primary function, that of naval auxiliaries. Travelling in company with regular warships, all of which in the Soviet fleet have considerable ASW capability, they would be extremely difficult targets.

It is now regular practice for an SSN to accompany a friendly task group, mainly to counter the threat posed by a similar enemy craft armed with anti-ship cruise missiles, such as the SS-N-7s or SS-N-9s carried in the 'Charlie II' class boats.

Those Soviet SSBNs with shorter-ranged weapons would need to be brought out into the open oceans despite very real geographical drawbacks. Submarine support operations are thus an important part of Soviet fleet doctrine and any attacking Western SSN would need to evade both A/S surface groups and others of her own kind. Though it is generally accepted that Soviet nuclear submarines are technologically inferior to their US counterparts, they are faster, and they do have numbers on their side despite the US target of 100 boats. Further, no matter how quiet the attacker, she advertises her presence the moment that she launches her first weapon. The initial attack will need to be successful, for the boat will be lucky to survive should she dally.

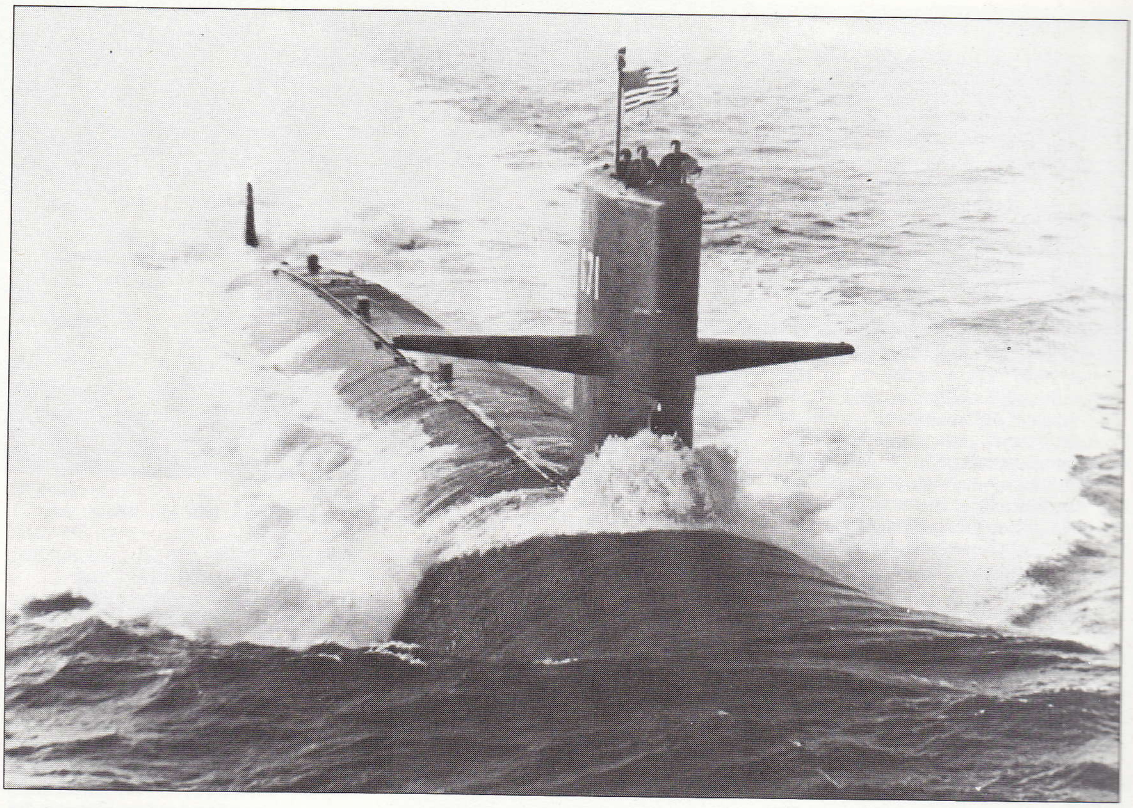
Submarining was always a game played for keeps. It needed men of a special calibre 40 years ago, and nothing has changed today.



USS Pogy *(SSN647). US attack submarines can increasingly be seen in British waters as they have mid-patrol rest sessions at selected ports during their patrol periods.*

USA

'Narwhal' and 'Glenard P. Lipscomb' class SSNs



USS Narwhal *(SSN671) is the testbed for the natural-circulation S5G nuclear reactor plant. The S5G uses natural convection rather than circulator pumps for heat transfer to the steam turbines in order to reduce the self-generated noise levels at low speeds.*

These two single-ship classes are testbeds for major new submarine technology. The USS **Narwhal** (SSN 671) was constructed in 1966-7 to evaluate the natural-circulation S5G nuclear reactor plant. This uses natural convection rather than several circulator pumps, with their associated electrical and control equipment, for heat transfer operations via the reactor coolant to the steam generators, thus effectively reducing at slow speeds one of the major sources of self-generated radiated machinery noise within ordinary nuclear-powered submarines. In all other respects the boat is similar to a 'Sturgeon' and will be retrofitted with new equipment and missiles in the course of a regular refit.

In contrast the USS **Glenard P. Lipscomb** (SSN 685) was constructed in 1971-3 to a much larger design to evaluate a turbine-electric drive propulsion plant. This eliminates the noisy reduction gear of the standard steam turbine plant and introduces a number of new and quieter machinery systems into the boat. However, because the system is much larger and heavier than the normal plant, a penalty has had to be paid in terms of underwater speed in comparison with that of contemporary American SSN classes. The *Lipscomb* is being used in an ongoing project designed to allow an actual at-sea evaluation of noise reduction techniques as a counter to ASW measures. Several of the quieting techniques which do not result in an underwater speed loss have already been incorporated in the 'Los Angeles' class. At present the two submarines operate in the Atlantic as fully operational units.

Specification

USS *Narwhal*

Displacement: 4,450 tons surfaced and 5,350 tons dived

Dimensions: length 95.9 m (314 ft 8 in); beam 11.6 m (38 ft 0 in); draught 7.9 m (25 ft 11 in)

Machinery: one General Electric S5G pressurized-water reactor powering two steam turbines driving one shaft

Speed: 18 kts surfaced and 26 kts dived

Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum

Torpedo tubes: four 533-mm (21-in) amidships

Basic load: 17 Mk 48 533-mm (21-in) torpedoes and six SUBROC anti-submarine missiles (being modified to 15 Mk 48 torpedoes, four SUBROC missiles and four Sub-Harpoon anti-ship missiles), or 46 Mk 57, Mk 60 or Mk 67 mines; in the late 1980s the load will comprise 11 Mk 48 torpedoes, four Sub-Harpoon missiles, four Tomahawk cruise missiles and four ASWSOW weapons

Missiles: none, but see above

Electronics: one BPS-11 surface-search radar, one BQQ-2 or BQQ-5 sonar suite (the latter with towed array), one Mk 113 or Mk 117 torpedo fire-control system, one WSC-3 satellite communications system, one ESM system, and one underwater telephone

Complement: 120

Specification

USS *Glenard P. Lipscomb*

Displacement: 5,800 tons surfaced and 6,840 tons dived

Dimensions: length 111.3 m (365 ft 0 in); beam 9.7 m (31 ft 9 in); draught 9.5 m (31 ft 0 in)

Machinery: one Westinghouse S5Wa pressurized-water reactor powering two steam turbines driving one shaft

Speed: 18 kts surfaced and 24 kts dived

Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum

Torpedo tubes: four 533-mm (21-in) amidships

Basic load: as for *Narwhal*

Missiles: none

Electronics: as for *Narwhal*

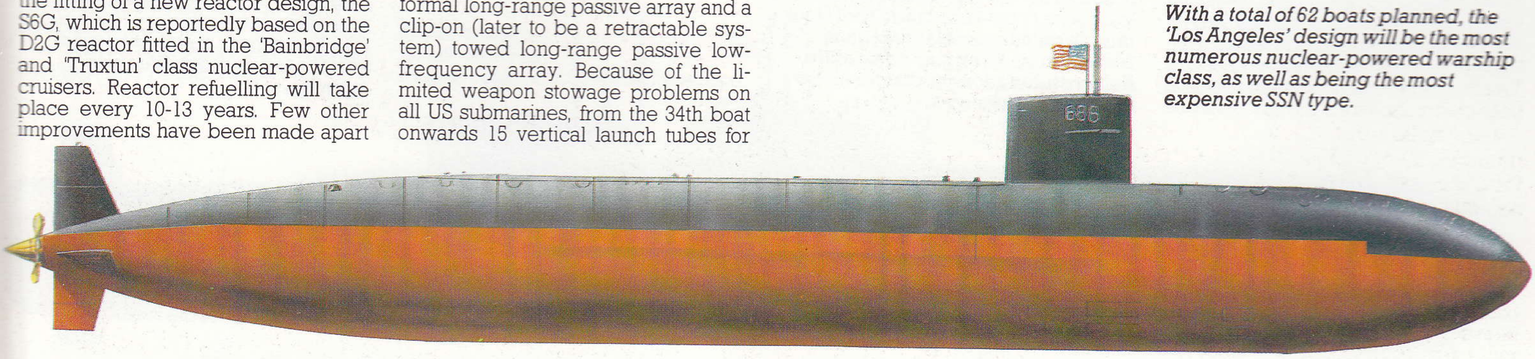
Complement: 120

USA

'Los Angeles' class SSN

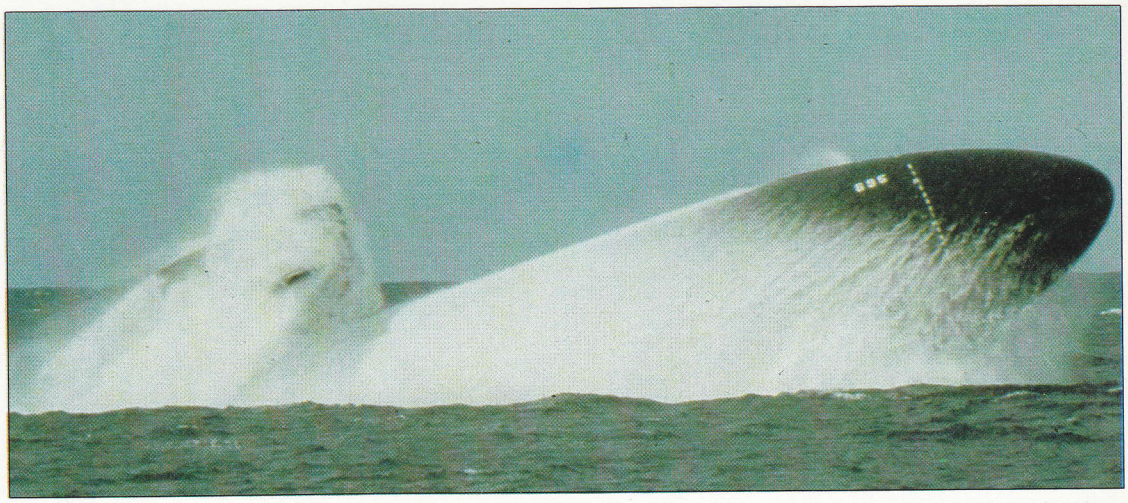
Destined to comprise the largest number of nuclear-powered warships built to one design, the **'Los Angeles' class** couples the speed advantage of the elderly 'Skipjack' class with the sonar and weapons capability of the 'Permit/Sturgeon' classes. The significant increase in size is mainly the result of doubling installed power available by the fitting of a new reactor design, the S6G, which is reportedly based on the D2G reactor fitted in the 'Bainbridge' and 'Truxtun' class nuclear-powered cruisers. Reactor refuelling will take place every 10-13 years. Few other improvements have been made apart from a slight increase in the weapon stowage space and in the addition of various underwater quieting aspects. The boats, built on a continuing basis since 1974, are fitted with the BQQ-5 sonar suite with a spherical long-range active/passive bow array, three passive target-ranging hydrophone arrays on each side of the hull, a conformal long-range passive array and a clip-on (later to be a retractable system) towed long-range passive low-frequency array. Because of the limited weapon stowage problems on all US submarines, from the 34th boat onwards 15 vertical launch tubes for Tomahawk cruise missiles will be fitted in the empty free-flooding space between the pressure hull and the bow sonar complex. The earlier ships will each carry up to 12 Tomahawks as part of their normal weapons outfit, to the detriment of the number of ASW weapons that can be carried. Already in operational service, the class has proved to be an exceptionally good ASW platform, although on one occasion on the first out-of-area 'Alpha I' deployment the Soviet boat was easily able to outrun a trailing 'Los Angeles' class boat off Iceland just by using its superior underwater speed. Against

With a total of 62 boats planned, the 'Los Angeles' design will be the most numerous nuclear-powered warship class, as well as being the most expensive SSN type.



more conventional Soviet nuclear-powered boats the success rate of detection and tracking is quite high, the BQQ-5 system on one occasion acquiring and holding contact with two Soviet 'Victor' class SSNs for an extended time. The high underwater speed of the 'Los Angeles' class boats allows them to be the first American SSN units to be capable of providing an effective underwater escort capability for American carrier battle groups. Previous SSNs were too slow for most of the missions assigned to such escorts. Currently six of the boats serve in the Pacific whilst another 16 are assigned to the Atlantic Fleet. It is estimated that another four will commission in late 1983, four in 1984, three in 1985, two in 1986, three in 1987 and three in 1988. At least another 21 are planned in future fiscal year construction programmes.

The names of the class so far are USS ***Los Angeles***, USS ***Baton Rouge***, USS ***Philadelphia***, USS ***Memphis***, USS ***Omaha***, USS ***Cincinnati***, USS ***Groton***, USS ***Birmingham***, USS ***New York City***, USS ***Indianapolis***, USS ***Bremerton***, USS ***Jacksonville***, USS ***Dallas***, USS ***La Jolla***, USS ***Phoenix***, USS ***Boston***, USS ***Baltimore***, USS ***City of Corpus Christi***, USS ***Albuquerque***, USS ***Portsmouth***, USS ***Minneapolis-St Paul***, USS ***Hyman G. Rickover***, USS ***San Francisco***, USS ***Atlanta***, USS ***Houston***, USS ***Norfolk***, USS ***Buffalo***, USS ***Salt Lake City***, USS ***Olympia*** and USS ***Newport News***. Eleven boats are as yet unnamed, and a further 21 are projected.



USS Birmingham *(SSN695) shows off an emergency surfacing drill during her sea trials. Note the large volumes of water pouring from her sail and the sail-mounted diving planes. A normal surfacing is achieved gradually by selective blowing of ballast tanks.*

Specification

'Los Angeles' class

Displacement: 6,000 tons surfaced and 6,900 tons dived

Dimensions: length 109.7 m (360 ft 0 in); beam 10.1 m (33 ft 0 in); draught 9.85 m (32 ft 4 in)

Machinery: one General Electric S6G pressurized-water reactor powering two steam turbines driving one shaft

Speed: 18 kts surfaced and 31 kts dived

Diving depth: 450 m (1,475 ft) operational and 750 m (2,460 ft) maximum

Torpedo tubes: four 533-mm (21-in) amidships

Basic load: 26 533-mm (21-in) weapons (Mk 48 torpedoes, SUBROC anti-submarine missiles on the first six boats, Sub-Harpoon anti-ship missiles and Tomahawk cruise missiles) or 52 Mk 57, Mk 60 or Mk 67 mines

Missiles: (from 34th boat onwards) 15 Tomahawk cruise missiles

Electronics: one BPS-15 surface-search radar, one modified BQQ-5 sonar suite with towed array, one Mk 113 (first 13 units) or Mk 117 (later units, and to be retrofitted in first 13) torpedo fire-control system, one WSC-3 satellite communications system, one ESM suite, and one underwater telephone

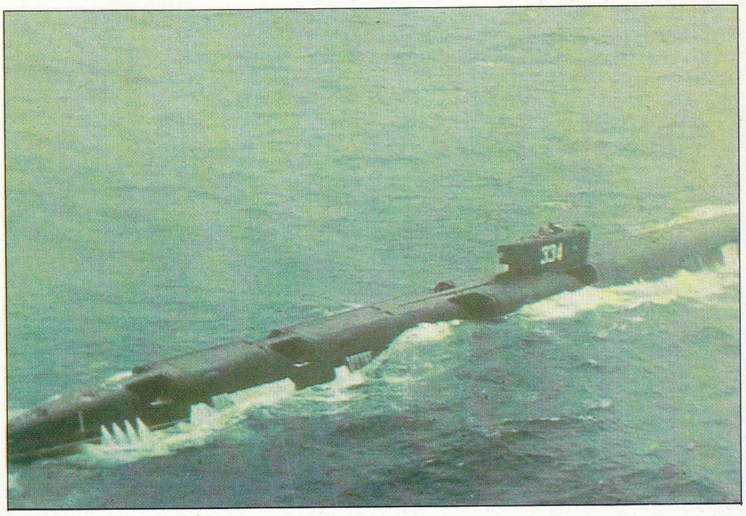
Complement: 127

USSR

'Echo' class SSN and 'Echo II' class SSGN

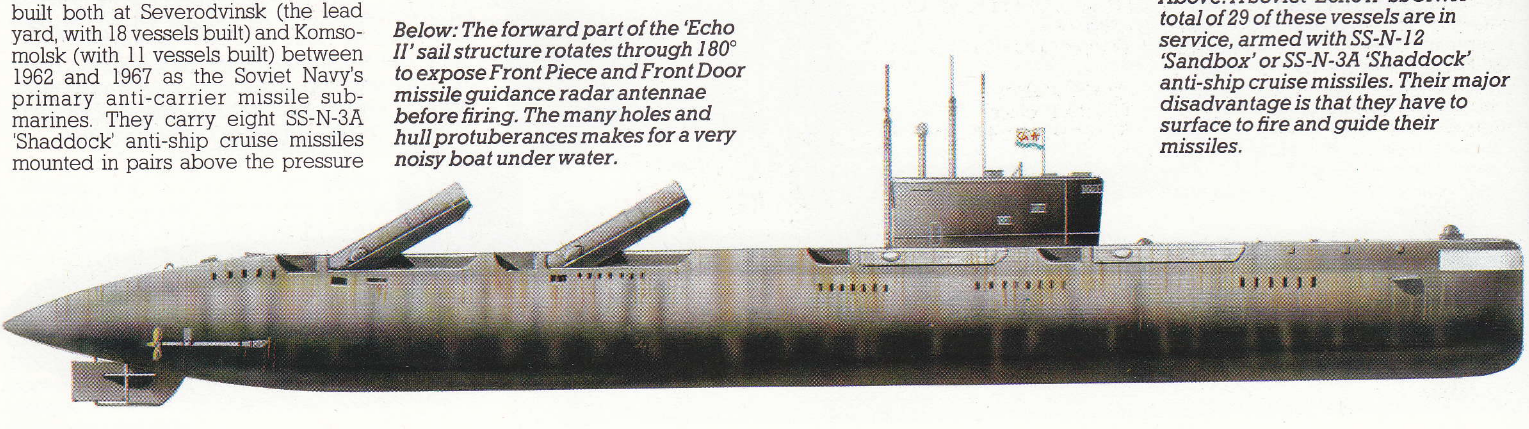
The five **'Echo' class** SSNs were originally built at Komsomolsk in the Soviet Far East between 1960-2 as **'Echo I' class** SSGNs. Armed with six tubes for the SS-N-3C 'Shaddock' strategic cruise missile, they lacked the fire-control and guidance radars of the later **'Echo II' class.** As the Soviet SSBN force was built up so the need for these boats diminished, and they were converted to anti-ship attack SSNs between 1969 and 1974. The conversion involved the removal of the 'Shaddock' tubes, the plating over and streamlining of the hull to reduce the underwater noise caused by the tube system, and modification of the sonar systems to the standard carried by the 'November' class SSNs. All were then deployed with the Pacific Fleet, although one suffered some damage several years ago in an internal fire and had to be towed back to its base near Vladivostok for emergency drydocking.

The follow-on 'Echo II' class was built both at Severodvinsk (the lead yard, with 18 vessels built) and Komsomolsk (with 11 vessels built) between 1962 and 1967 as the Soviet Navy's primary anti-carrier missile submarines. They carry eight SS-N-3A 'Shaddock' anti-ship cruise missiles mounted in pairs above the pressure hull, and for firing have to surface and elevate the pairs to about 25-30°. The forward section of the sail structure then rotates through 180° to expose the two 'Front' series missile-guidance radars. The firing in pairs of all eight missiles probably takes around 30 minutes, and the submarine then has to remain on the surface until the missile mid-course correction and final target-selection commands have been sent unless guidance can be passed over to a third party such as a naval air force Tupolev Tu-142 'Bear-D' fitted with the appropriate command guidance system. From the mid-1970s the 'Echo II' class boats have gradually been converted during routine overhauls to carry the longer-range and much faster SS-N-12 'Sandbox' anti-ship cruise missile in place of the 'Shaddocks'. The conversions can be distinguished by the fitting of bulges to each side of the sail and at the forward end of the mis-



Above: A Soviet 'Echo II' SSGN. A total of 29 of these vessels are in service, armed with SS-N-12 'Sandbox' or SS-N-3A 'Shaddock' anti-ship cruise missiles. Their major disadvantage is that they have to surface to fire and guide their missiles.

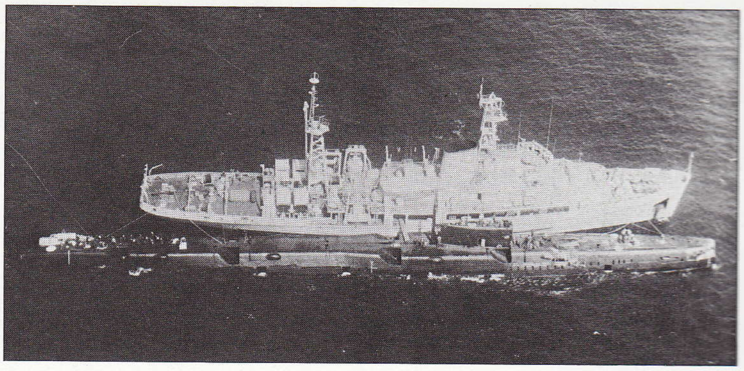
Below: The forward part of the 'Echo II' sail structure rotates through 180° to expose Front Piece and Front Door missile guidance radar antennae before firing. The many holes and hull protuberances makes for a very noisy boat under water.



sile tubes abreast the bridge. The 'Echo II' boats are split about evenly between the Pacific and Northern Fleets, with one unit of the latter normally to be found in the Mediterranean with a 'Juliett' class SSG.

Specification
'Echo' class
Displacement: 4,500 tons surfaced and 5,500 tons dived
Dimensions: length 110.0 m (360 ft 11 in); beam 9.0 m (29 ft 6 in); draught 7.5 m (24 ft 7 in)
Machinery: one pressurized-water reactor powering two steam turbines driving two four-blade propellers
Speed: 20 kts surfaced and 28 kts dived
Diving depth: 300 m (985 ft) operational and 500 m (1,640 ft) maximum
Torpedo tubes: six 533-mm (21-in) bow and two 406-mm (16-in) stern
Basic load: 20 533-mm (21-in) torpedoes (16 anti-ship or anti-submarine HE and four anti-ship 15-kiloton nuclear) and two 406-mm (16-in) anti-ship torpedoes
Missiles: none
Electronics: one 'Snoop Tray' surface-search radar, one Hercules sonar, one Feniks sonar, one 'Stop Light' ESM system and one underwater telephone
Complement: 90

Specification
'Echo II' class
Displacement: 5,000 tons surfaced and 6,000 tons dived
Dimensions: length 115.0 m (377 ft 4 in); beam 9.0 m (29 ft 6 in); draught 7.5 m (24 ft 6 in)
Machinery: as for 'Echo' class
Speed: 20 kts surfaced and 25 kts dived
Diving depth: as for 'Echo' class
Torpedo tubes: as for 'Echo' class
Basic load: as for 'Echo' class
Missiles: eight SS-N-3A 'Shaddock' (four with 1000-kg/2,250-lb HE and four with 350-kiloton nuclear warheads) or (in seven or eight converted boats) eight SS-N-12 'Sandbox' (four with 1000-kg/2,205-lb HE and four with 350-kiloton nuclear warheads)
Electronics: as for 'Echo' class, but with the addition of one 'Front Door' and one 'Front Piece' missile-guidance radar
Complement: 100



On 28 August 1976 an 'Echo II' class vessel collided with USS* Voge*, a 'Garcia' class frigate, in the Ionian sea. The 'Echo II' suffered severe hull lacerations and sail damage, and was patched up by a 'Prut' class submarine salvage vessel before sailing back to port for repairs.

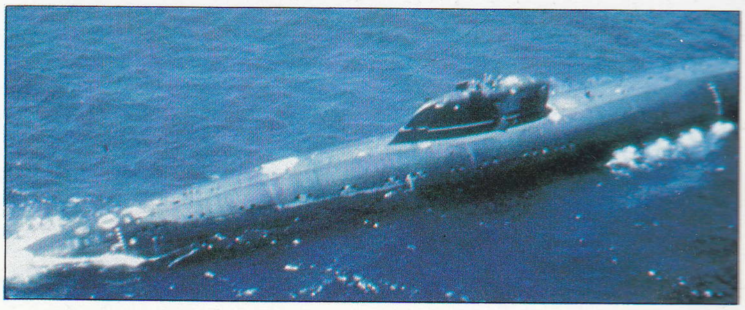
USSR

'Charlie I', 'Charlie II' and 'Charlie III' class SSGNs

Designated PLARK by the Soviets, the first **'Charlie I' class** SSGN was launched at the inland shipyard at Gorki in 1967. Over the next five years a further 10 were completed there, with two banks of four missile tubes angled upwards on each side of the bow external to the pressure hull to give the class a distinctive blunt nose appearance. The tubes have large outer doors and are designed to carry the short range SS-N-7 submerged-launch anti-ship missile for the pop-up surprise attack on high-value surface targets such as a carrier. From 1972 to 1979 at Gorki an improved **'Charlie II' class** design was built with a 9-m (29.5-ft) hull insertion in the hull forward of the fin for the electronics and launch systems necessary for targeting and firing the SS-N-15 and SS-N-16 weapons. The four 'Charlie II' class boats also carry the longer-range SS-N-9 anti-ship missile in place of the SS-N-7. About 1980 the third and final variant of the design, the **'Charlie III' class**, appeared at Gorki, and this may be fitted to fire an underwater-launched variant of the SS-N-22 anti-ship missile, which is a longer-range and higher-speed development of the SS-N-9. In all three classes, once the missiles have been fired the boat has to be reloaded back at port, although the secondary torpedo armament and sonar systems allow each boat to be used as a useful anti-ship and ASW platform if required in the interim. The 'Charlie III' production cycle (three boats completed and two building) is believed to be about to be ended, and it is believed that a new light/medium SSGN class will be built at Gorki to complement the larger 'Oscar' class. The 'Charlie' class boats serve with the Northern and Pacific Fleets.

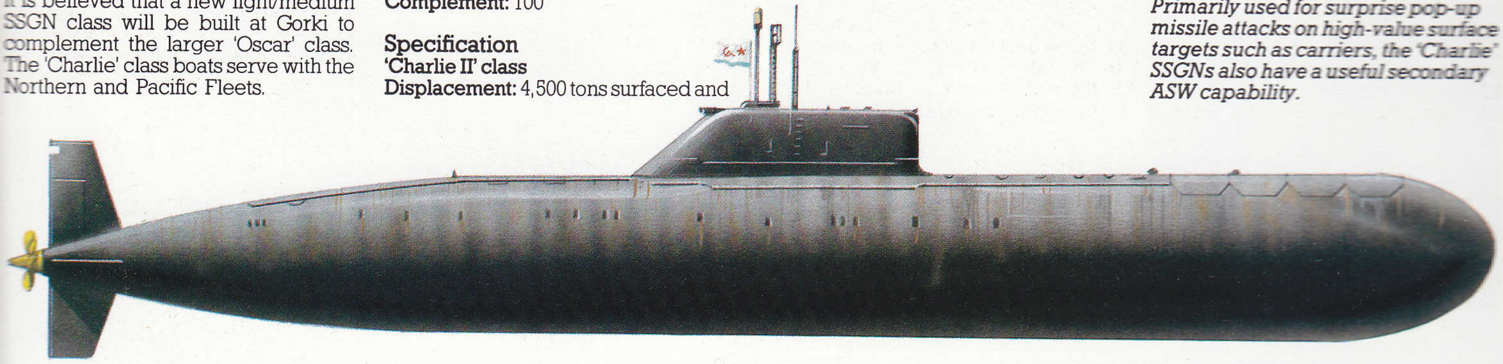
Specification
'Charlie I' class
Displacement: 4,000 tons surfaced and 5,000 tons dived
Dimensions: length 93.9 m (308 ft 1 in); beam 10.0 m (32 ft 7 in); draught 7.8 m (25 ft 7 in)
Machinery: one pressurized-water reactor powering two steam turbines driving one five-blade main propeller and two two-blade quiet propellers
Speed: 20 kts surfaced and 27 kts dived
Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum
Torpedo tubes: six 533-mm (21-in), two with 406-mm (16-in) liners, all bow
Basic load: maximum of 12 533-mm (21-in) torpedoes, but normally a mixture of four 533-mm (21-in) anti-ship or anti-submarine HE, six 406-mm (16-in) anti-submarine HE and two 533-mm (21-in) anti-ship 15-kiloton nuclear torpedoes plus two SS-N-15 15-kiloton anti-submarine missiles, or a total of 24 AMD-1000 ground mines
Missiles: eight SS-N-7 (four with 500-kg/1,102-lb HE and four with 200-kiloton nuclear warheads)
Electronics: one 'Snoop Tray' surface-search radar, one low-frequency bow sonar, one medium-frequency missile and torpedo fire-control sonar, one 'Brick Spit' and one 'Brick Pulp' passive intercept and threat-warning ESM system, one 'Park Lamp' direction-finding antenna, VHF and UHF communications, and one underwater telephone
Complement: 100

Specification
'Charlie II' class
Displacement: 4,500 tons surfaced and 5,500 tons dived
Dimensions: length 102.9 m (337 ft 7 in); beam 10.0 m (32 ft 10 in); draught 7.8 m (25 ft 7 in)
Machinery: as for 'Charlie I' class
Speed: 20 kts surfaced and 26 kts dived
Diving depth: as for 'Charlie I' class
Torpedo tubes: as for 'Charlie I' class but with the addition of two 618-mm (24.33-in) in the bows for SS-N-16
Basic load: as for 'Charlie I' class but with two SS-N-16 anti-submarine missiles
Missiles: eight SS-N-9 'Siren' (four with 500-kg/1,102-lb HE and four with 200-kiloton nuclear warheads)
Electronics: as for 'Charlie I' class but with the addition of one VLF towed communications buoy and one ELF floating communications antenna
Complement: 110



A 'Charlie I' class SSGN. This sub-class carries the SS-N-7 J-band active radar homing anti-ship missile in two banks of four missile tubes, angled upwards either side of the bow external to the pressure hull.

Specification
'Charlie III' class
Displacement: as for 'Charlie II' class
Dimensions: as for 'Charlie II' class
Machinery: as for 'Charlie II' class
Speed: as for 'Charlie II' class
Diving depth: as for 'Charlie II' class
Torpedo tubes: as for 'Charlie II' class
Basic load: as for 'Charlie II' class
Missiles: eight SS-N-22
Electronics: as for 'Charlie II' class
Complement: as for 'Charlie II' class



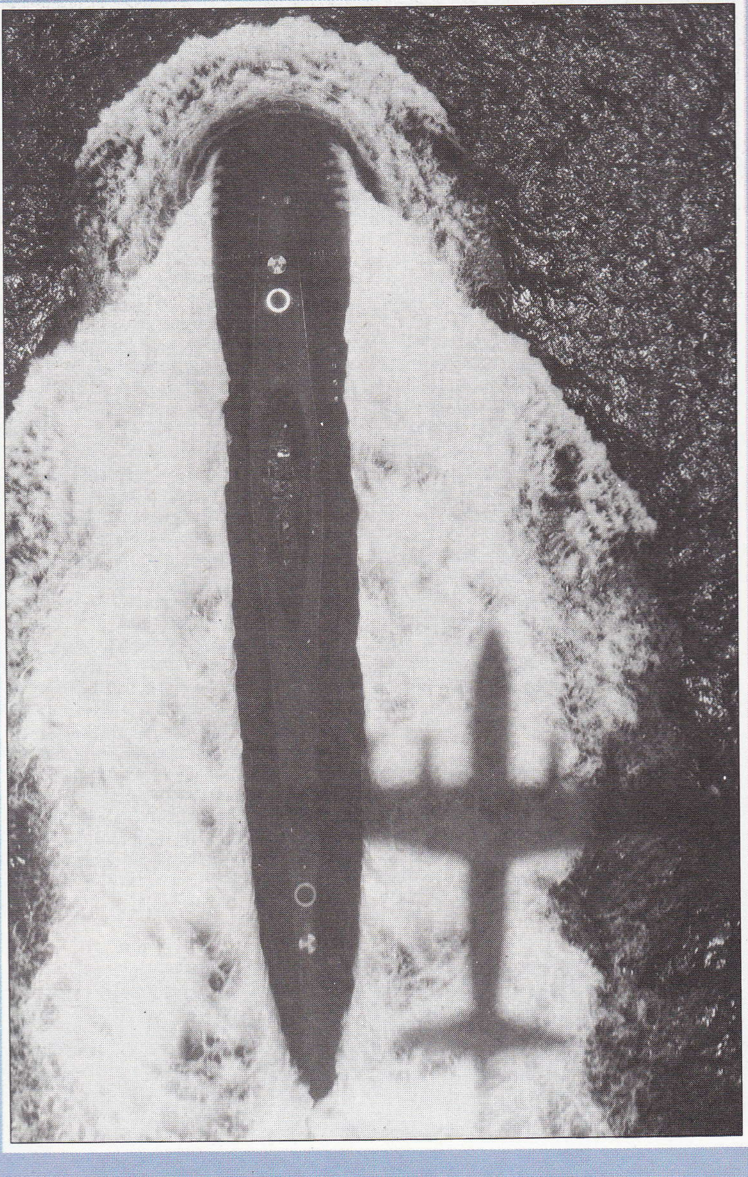
A total of 20 'Charlie' class SSGNs have been built in three sub-classes since 1967 at the Gorki shipyard. Primarily used for surprise pop-up missile attacks on high-value surface targets such as carriers, the 'Charlie' SSGNs also have a useful secondary ASW capability.

Soviet Attack Submarines Methods and Tactics

The Soviet nuclear submarine attack force is one of the primary elements in the Soviet navy's first strike policy against NATO's naval assets. It is a highly controlled force with both attack and cruise missile submarines of all capabilities forming the assault units and is continually being upgraded as new boats and weapons are introduced.

If, by the term 'attack submarine', one understands a nuclear-propelled boat armed with torpedoes and/or non-strategic cruise missiles, the Soviets have a very mixed bag of about 126 units, varying greatly in potential. Some 29 are elderly 'Echo II' class boats armed with the long-range SS-N-3 or SS-N-12. They need to surface at least in part for weapon launch, and, when submerged, are noisy and slow. Seventeen others are torpedo-armed 'Echo' and 'November' class boats probably too limited for first-line service but useful in 'operational' anti-SLOC (Sea Lines Of Communication) roles. Of the remainder, there are around 40 'Victor' class and nine converted 'Yankee' SSNs of various configurations but all of high submerged speed and suitable for ASW, particularly 'strategic' anti-SSBN missions. They have torpedoes and the stand-off SS-N-15 A/S missile. The 20 'Charlie' class boats are slower but have a variety of submerged launch anti-ship cruise missiles. The remaining boats comprise the single 'Papa' prototype and a growing number of 'Oscar' class SSGNs with the vertical-launched SS-N-19 anti-ship cruise missile. Finally there are seven or eight 'Alpha' class boats, credited with extreme diving depths (up to 1000 m/ 3,280 ft) and a speed in excess of 40 kts. All the latter classes are first-rate craft, capable of working against heavily-defended 'operational' or 'tactical' targets such as enemy surface attack groups. All the nuclear-powered cruise-missile boats (SSGN) could also be deployed to strike shore targets not covered by strategic missiles in extreme emergency.

A 'Victor I' class SSN passes through the Straits of Malacca en route to the Pacific Fleet in 1974. The 'Victor' class is the first Soviet design specifically for ASW operations.



Bearing in mind that material published by the Soviets with regard to their submarines may be deliberately misleading, it is still possible to glean clues as to their methods of use in time of war. Fleet Admiral Gorshkov himself testifies to the overriding importance of the strategic missile-armed SSBNs and, though not committing himself to reserving them in 'sanctuary' areas for use as bargaining chips, does allude to the problems that this would cause Western SSNs wishing to attack them and notes the fact that the reverse is also true. Soviet SSNs would, therefore, be greatly involved with the support of friendly SSBNs and the destruction of those of the enemy. They would not necessarily work alone, however, for Soviet doctrine, frequently exercised, is aimed toward mounting co-ordinated attacks from a variety of mutually-supportive platforms, submarine, surface and aerial. The complexity of such attacks demands the requirement of centralized control, so much of the initiative demanded of Western SSN skippers in their 'lone ranger' roles would be unnecessary.

A further, but very important, point is that the Soviets appear more willing than the West to accept losses. If they lack in quality they certainly do not in quantity, and numerical superiority would be used quite crudely to entice a Western boat to betray its presence in order that it could be attacked. This would involve 'coat-trailing' and, if it resulted in attrition at the rate of one-for-one, this would be quite acceptable.

Geography severely circumscribes the Soviet Union. Unless her forces can pre-emptively seize and hold their respective narrow exits, both the Baltic and Black Sea fleets would be unusable in war. Despite this the Mediterranean could not be allowed to become a NATO 'pond', a protected zone for its SSBNs, so Soviet SSNs would need to transit continuously to and from the Northern Fleet, in the course of which they would have to navigate the choke points of the Greenland-Iceland-UK gap, Gibraltar Strait and, possibly, the Sicilian narrows.

Realistically, every available unit would be at sea and on station before the start of hostilities, ready for the massive initial blow. With centralized control, the amount of resultant signal traffic, even on VLF transmission, will have alerted the West which must be tempted, as a result, to strike at the 'brain' which, in order to function, would need a vast inflow of information from a variety of reconnaissance platforms.

Initial targets, not necessarily in order of priority, would be the West's (particularly American) carrier attack groups, resupply convoys, Western SSBNs and key shore targets. During passage Soviet SSNs may well keep in company for mutual support, even on the surface in areas covered by friendly air power, to reduce the threat from mines and A/S weapons from Western boats. Once on submerged passage, speed, unless dictated otherwise, would be selected for minimum radiated noise. It is invariably assumed that Soviet boats are noisier than those of the West, but it could well be that noisy operation is a peacetime tactic. Once in the position dictated by the central command, the SSN must be identified as such from time to time for the co-ordination of an attack.

An assault on an important ship concentration would involve allocating specific sectors to SSNs and SSG/SSGNs to avoid their mutual interference. Range and bearing would be determined by armament and ability to disengage rapidly after launch, together with the number of submarines taking part. Boats would also need to be 'held' while the attack force was being built up.

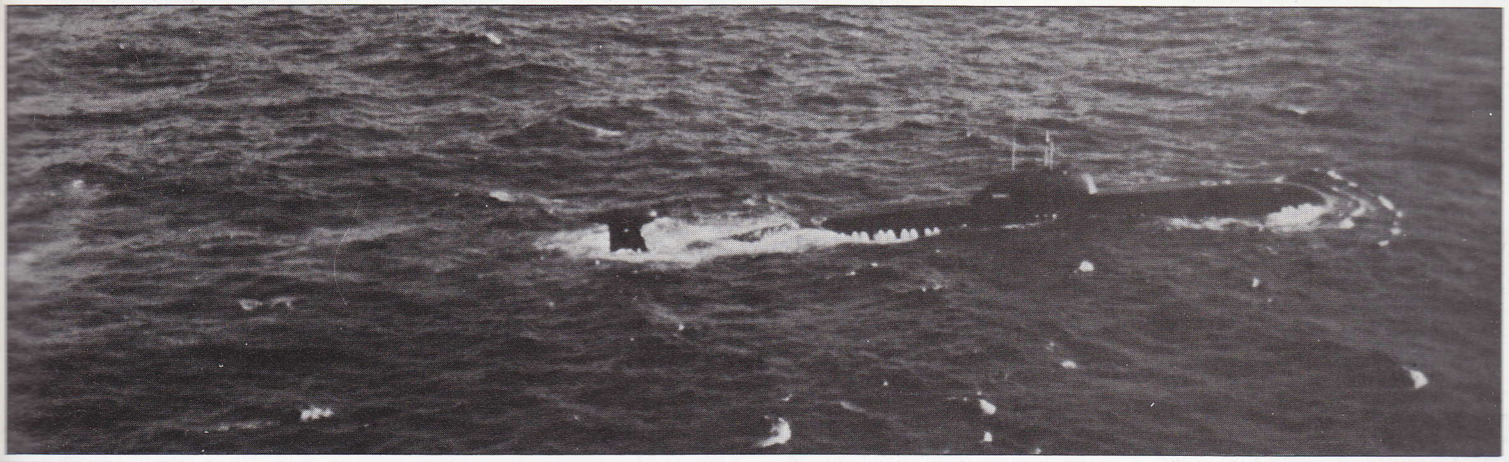
A possible attack programme would involve several initial and widely-spread probes by aircraft such as the Tupolev Tu-22M/Tu-26 'Backfire', working on the fringe of the carrier's CAP zone. Supported by EW-fitted units, some of the 'Backfires' would carry air-to-surface missiles. Having split up the CAP, the aircraft would launch their ASMs, virtually simultaneously. A Tupolev Tu-142 'Bear-D' would direct the aircraft attacks and, if central control has managed to get any SS-N-3/12 boats on the scene, would provide guidance to its missiles in flight. Once the surface group under attack has become committed, these submarines could safely be surfaced for their launch. Closer-in would be SS-N-7-armed boats, whose entrance would be timed by control to take maximum advantage of the initial confusion. As up to about one in four of the incoming weapons could be nuclear-tipped, every one would need to be shot down. This force would have the further job of finishing off any damaged ships by torpedo.

Failing such aerial assistance, attacking submarines would be very much more limited. As it would be unlikely that a central control would have a plot accurate enough for the setting-in of missile launch data, the boats would need to close the target group sufficiently to use active sonar or even radar for targeting purposes. Either course would lay them open to detection and counterattack. The course of action would probably be to use a missile as a reconnaissance platform, sweeping a path either side of the suspected bearing of the target. The radar picture from the missile would be sent via a data link back to the submarine, which would designate the target when a group of ships was found.

A major headache for the would-be attacker is the SSN (or two) that normally

Above: Soviet ballistic missile submarines such as the large 'Delta III' class are prime targets for Western attack submarines; one of the main functions of Soviet nuclear attack submarines is the protection of such missile craft from opposing vessels.

Below: Protection is increasingly provided by such modern submarines as the 'Victor III' class. With advanced electronics, and coated with sound-deadening material, 'Victor III' vessels are probably as capable as a large proportion of the US attack force.



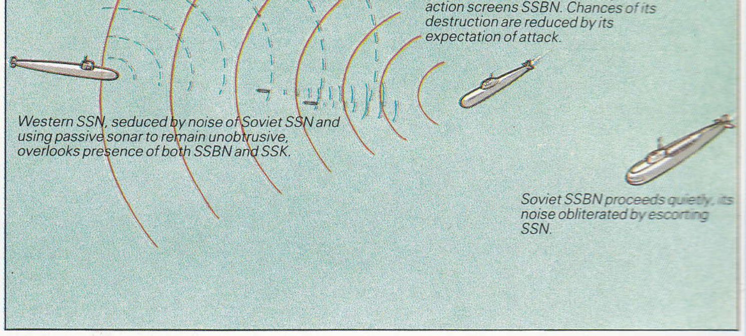
accompanies a valuable surface group. This, being inherently quieter, has the initial advantage but, once it or they have used active sensors and launched weaponry, the Soviets will have broken cover and will have nothing to lose by fast (noisy) disengagement. As the presence of a Western SSN is to be expected, active ranging to pinpoint and target it would also be in order once the attack has been initiated.

Western SSNs would not be hunted down as a matter of course as this would be an uneconomic use of available assets: far better to tackle those that can be found more easily. Besides those in the company of surface groups, there would be others attempting to penetrate 'sanctuary' areas. This would be the problem tasked to advanced boats such as the 'Alpha' and later 'Victor' class boats, the former believed to be only torpedo-armed (a limitation compensated by an ability to out-run and out-dive an adversary), while the latter has ballistic A/S weapons in addition. These can be nuclear-tipped to 'sanitize' a considerable area if the target is only vaguely located, of high value (such as an SSBN) or looks like escaping.

Soviet design policy seems to be a regression to the 'traditional' double-hulled boat. While bulkier, these have the asset of a free-flooding space within the skins, space which can be used for pressure-tight missile stowage/launch canisters and which, more significantly, acts like the anti-torpedo bulges on the surface warships of earlier in the century. Small A/S torpedoes have the classic conflicting design demands of buoyancy, strong hulls, endurance, speed, intelligence and warhead size. An improvement in any one is usually at the expense of the remainder, so warheads have tended to lose out and become smaller. A double-hulled boat may well survive a hit from such a weapon, so some form of energy-directed head will be required for a hit to be effective.

It has been reported that the Soviets are well advanced in the production of a Tomahawk-type, submerged-launch cruise missile, with the Western designation SS-NX-21. Stand-off attacks against shore targets such as particularly sensitive factories or installations, temporary concentrations or dumps, or anything geographically small but of high value can well be expected. For this, a Soviet SSN would probably need to traverse shallow continental shelf waters, running at very low speed to remain unobtrusive. It is in such circumstances that she surrenders her great advantages and can be tackled by the highly cost-effective SSKs, the conventional diesel-electric boat, and it suggests that the USA's abandonment of these could be a short-sighted decision.

Below: Whilst within range of friendly air cover, an SSBN may well proceed on surface to minimize mine threat and maximize problems for Western SSNs. To pass through choke points such as the Greenland-Iceland-UK gap, the SSBN is submerged but supported by other submarines, aircraft or surface group vessels.


Soviet diesel-electric SSK keeps bows-on to Western SSN to minimize own sonar profile. Using passive sonar only, it tracks friendly SSN by its powerful active emissions and Western SSN by much weaker reflected emissions. With latter intent upon another target, SSK's chances of a 'kill' are greatly enhanced.
Reflected energy emissions
Soviet SSN deliberately draws attention to itself by using active sonar. This will warn it of enemy SSN's presence and of any approaching torpedoes. Noisy evasive action screens SSBN. Chances of its destruction are reduced by its expectation of attack.
Western SSN, seduced by noise of Soviet SSN and using passive sonar to remain unobtrusive, overlooks presence of both SSBN and SSK.
Soviet SSBN proceeds quietly, its noise obliterated by escorting SSN.

USSR

'Papa' and 'Oscar' class SSGNs

In 1970 the Soviet shipyard at Severodvinsk launched a single unit of what came to be known in NATO circles as the **'Papa' class**. The 'Papa' class boat was considerably larger and carried two more missile tubes (for an unidentified type of missile) than the contemporary 'Charlie' class SSGNs, and was for many years a puzzle to Western intelligence services. However, the answer appeared in 1980 at the same shipyard when the first of the even larger **'Oscar' class** of SSGN was launched; the 'Papa' class unit had been the prototype for advanced SSGN concepts with a considerably changed powerplant and revised screw arrangement. The missile system had been to test the underwater-launched version of the SS-N-9 'Siren' for the subsequent 'Charlie II' series of SSGN. The 'Oscar' design introduced yet further improvements, with two 12-round banks of submerged-launch long-range SS-N-19 anti-ship missile tubes set in elevation at an angle of 40° and external to the main pressure hull on each side of the fin. Assessed as the underwater equivalents to the battlecruiser 'Kirov' by several authoritative sources, the boats of the 'Oscar' class are believed to be designed to operate in conjunction with surface battle groups built around those ships. Both types of SSGN are designated as PLARK (*podvonaya lodka atomnaya raketnaya krylataya*, or nuclear-powered cruise missile submarine) by the Soviets, and operate with the Soviet Northern Fleet from the Kola peninsula. The current pair of 'Oscar' class boats will probably be supplemented by another eight boats.

Specification
'Papa' class

Displacement: 6,100 tons surfaced and 7,000 tons dived
Dimensions: length 109.0 m (357 ft 7 in); beam 11.5 m (37 ft 9 in); draught 7.6 m (24 ft 11 in)
Machinery: one pressurized-water reactor powering two steam turbines driving two shafts
Speed: 20 kts surfaced and 35-40 kts dived
Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum
Torpedo tubes: six 533-mm (21-in), two with 406-mm (16-in) liners, all bow
Basic load: maximum of 12 533-mm (21-in) torpedoes, but normally a mixture comprising four 533-mm (21-in) anti-ship or anti-submarine HE, six 406-mm (16-in) anti-submarine HE and two 533-mm (21-in) anti-ship 15-kiloton nuclear torpedoes plus two SS-N-15 15-kiloton anti-submarine missiles, or a total of 24 AMD-1000 ground mines
Missiles: 10 SS-N-9 'Siren' (six with 500-kg/1,102-lb HE and four with 200-kiloton nuclear warheads)
Electronics: one 'Snoop Tray' surface-search radar, one low-frequency bow sonar, one medium-frequency torpedo and missile fire-control sonar, one 'Brick Spit' and one 'Brick Pulp' passive intercept and threat-warning ESM system, VHF/UHF communications, one 'Park Lamp' direction-finding antenna, and one underwater telephone
Complement: 110

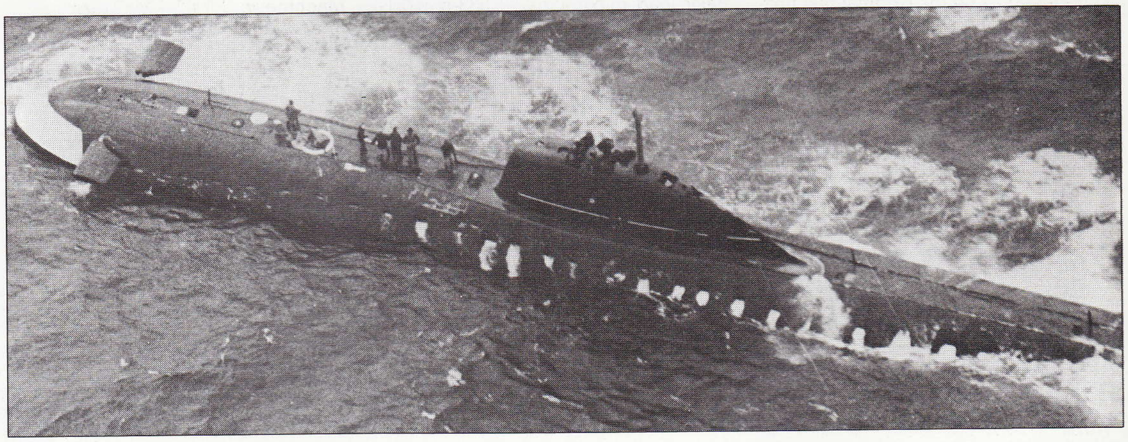
Specification
'Oscar' class

Displacement: 10,000 tons surfaced and 14,000 tons dived
Dimensions: length 143.0 m (469 ft 2 in); beam 18.3 m (60 ft 0 in); draught 11.0 m (36 ft 1 in)
Machinery: two pressurized-water reactors powering two steam turbines driving two shafts
Speed: 20 kts surfaced and 30-35 kts dived
Diving depth: 500 m (1,640 ft) operational and 830 m (2,725 ft) maximum
Torpedo tubes: six 533-mm (21-in), two with 406-mm (16-in) liners, all bow
Basic load: maximum of 24 533-mm (21-in) torpedoes, but normally a mixture comprising 10 533-mm (21-in) anti-ship or anti-submarine HE, 14 406-mm (16-in) anti-submarine HE and four 533-mm (21-in) anti-ship 15-kiloton nuclear torpedoes plus two SS-N-15 15-kiloton anti-submarine missiles and two SS-N-16 anti-submarine missiles, or a total of 48 AMD-1000 ground mines and the two SS-N-16s
Missiles: 24 SS-N-19 (18 with 1000-kg/2,205-lb HE and six with 500-kiloton nuclear warheads)
Electronics: as for 'Papa' class except one new-type 'Snoop' series surface-search radar, one VLF towed communications buoy and one ELF floating communications antenna
Complement: 130

USSR

'November' class SSN

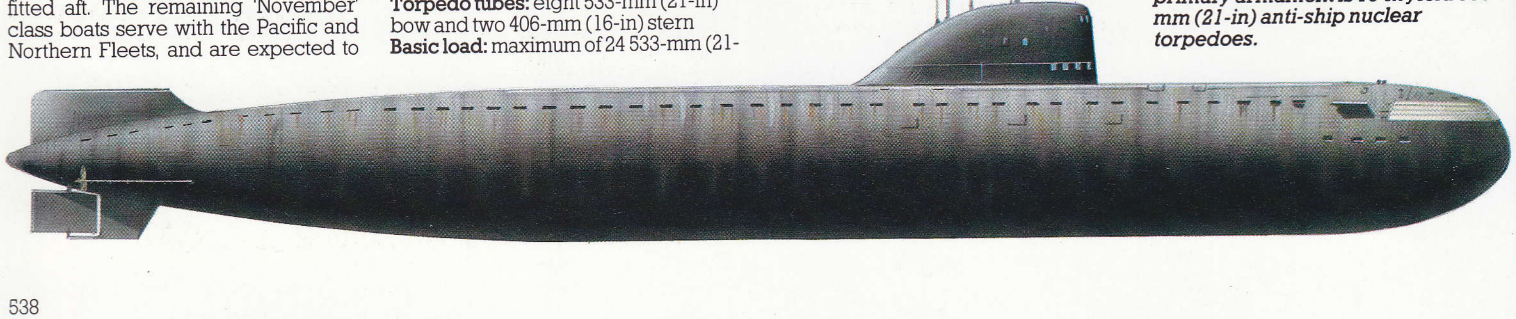
Built as the Soviets' first nuclear-powered submarine design from 1958 to 1963 at Severodvinsk, the 14-vessel **'November' class** was designed for the anti-ship rather than anti-submarine roles. Armed with nuclear torpedoes, the task of these boats was and still is to attack carrier battle groups in the hope of getting a clear shot at the carrier itself. The hull form, elderly reactor design and the many free flood holes in the casing make this type very noisy underwater. They are also considered to be, together with the 'Echo I' SSGN and 'Hotel' SSBN classes based on the 'November' design, something of a radiation hazard to their crews because of design defects and poor shielding. It is known that several specialist hospitals have been set up in the Soviet Union to treat the radiation casualties from these boats, and it is reported that they acquired the nickname 'widow-makers' amongst Soviet submarine crews. In April 1970 a 'November' class boat was lost south west of the United Kingdom after an internal fire, the crew being taken off before the boat sank, and there have also been numerous incidents of the three classes suffering machinery breakdowns whilst on operational patrol. At least one 'November' and two 'Hotel' class boats have been scrapped in recent years, while several other 'November' class units have been retired to reserve status. Retractable hydroplanes are carried just aft of the bow sonar systems, and two 406-mm (16-in) anti-escort torpedo tubes are fitted aft. The remaining 'November' class boats serve with the Pacific and Northern Fleets, and are expected to pay off rapidly as new boats enter service over the next few years.



The 'November' class SSN, the 'Echo' class SSN, 'Echo II' class SSGN and the 'Hotel II' class SSBN are characterized in Soviet navy service by the number of breakdowns they have suffered on operational patrol. The 'November' class boat seen here subsequently sank in April 1970.

Specification
'November' class

Displacement: 4,200 tons surfaced and 5,000 tons dived
Dimensions: length 109.7 m (359 ft 11 in); beam 9.1 m (29 ft 10 in); draught 6.7 m (22 ft 0 in)
Machinery: one pressurized-water reactor powering two steam turbines driving two four- or six-bladed propellers
Speed: 20 kts surfaced and 30 kts dived
Diving depth: 300 m (985 ft) operational and 500 m (1,640 ft) maximum
Torpedo tubes: eight 533-mm (21-in) bow and two 406-mm (16-in) stern
Basic load: maximum of 24 533-mm (21-in) torpedoes, normally a mixture of 18 533-mm (21-in) anti-ship or anti-submarine and six 533-mm (21-in) anti-ship 15-kiloton nuclear torpedoes, plus two 406-mm (16-in) anti-ship torpedoes
Missiles: none
Electronics: one 'Snoop Tray' surface-search radar, one 'Stop Light' ESM system, one medium-frequency Hercules bow sonar, one medium-frequency Feniks bow sonar, VHF/UHF communications and one underwater telephone
Complement: 86



Nicknamed 'widow makers' in Soviet naval service because of poor reactor shielding, the 'November' class is expected to be retired rapidly over the next few years as more modern and much safer submarines enter service. Their primary armament is 15 kt yield 533-mm (21-in) anti-ship nuclear torpedoes.

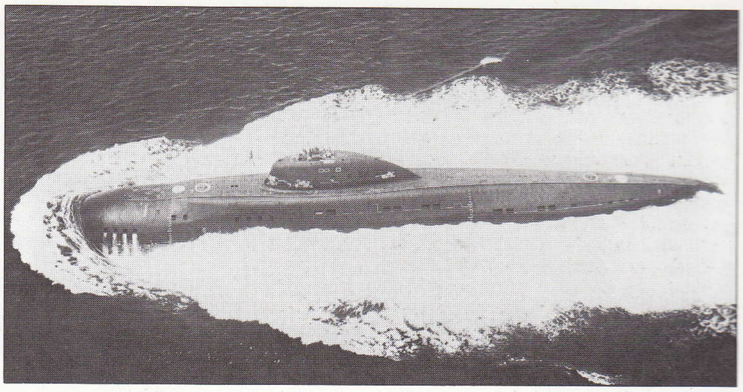
USSR

'Victor I', 'Victor II' and 'Victor III' class SSNs

The **'Victor I' class** is designated by the Soviets as a PLA (*podvodnaya lodka atomnaya*, or nuclear-powered submarine), and together with the contemporary 'Charlie I' SSGN and 'Yankee' SSBN classes formed the second generation of Soviet nuclear submarines. The 'Victor' and 'Charlie' class boats were the first Soviet submarines built to the teardrop hull design for high underwater speeds. The first 'Victor' was completed in 1967 at the Admiralty Shipyard, Leningrad, where the last of 16 units was completed in 1974. The 'Victor I' boats are the fastest pressurized-water reactor-powered SSNs afloat, even with the advent of the American 'Los Angeles' class. The enriched uranium fuelled reactor is of the same type as installed in both the 'Charlie' and 'Yankee' class vessels. In 1972, the first of the improved **'Victor II' class** was built at the Gorki shipyard, being produced in alternate years to the 'Charlie II' design there. Four were built there, whilst another two were apparently constructed at the Admiralty Shipyard in 1975 as an interim measure whilst the first of the more complex **'Victor III' class** units were being laid down. Initially called the **'Uniform' class** by NATO, the 'Victor II' class is marked by a 6.1 m (20 ft) extension inserted into the hull forward of the sail for what is believed to be the original test fire-control and launch equipment for the SS-N-15/16 ASW missiles.

In 1976 the first of the 'Victor III' units was launched at the Admiralty Shipyard, and this class has subsequently been built there at the rate of one per year. In 1978 the Komsomolsk yard joined the production team, building two boats per year after the end of 'Delta I' class production. A total of 18 'Victor III' class boats is likely, with production stopping in 1982 at the Admiralty Shipyard and in 1983 at Komsomolsk. The follow-on class in both places is likely to be the 'Alpha II' class SSN. The improvement over the 'Victor II' represented by the 'Victor III' class is a 3 m (9 ft 10 in) hull extension forward of the fin and a pod mounted atop the upper rudder for what is thought to be the first Soviet submarine-mounted towed sonar array. The extension probably provides the extra volume for the additional electronic equipment required to process the data from the array. All three classes are coated with the 'Clusterguard' anechoic coating developed to reduce the effectiveness of active sonar systems on NATO ships, submarines and ASW torpedoes. It is also known that there is a decrease in radiated noise levels as the design was improved, the 'Victor III' class being described officially in US Navy circles as the equivalent to the USS 'Sturgeon' class SSN in quietness. They also have bow hydroplanes that retract into the hull at high underwater speeds or when a boat is on the surface.

Like all boats after the 'Hotel' SSBN, 'Echo' SSGN and 'November' SSN classes, the 'Victor' class boats have had two of their 533-mm (21-in) tubes fitted with 406-mm (16-in) ASW torpedo liners for self-defence use. Two of these weapons are carried in the place of every 533-mm (21-in) reload offloaded. In recent months a 'Victor III' class boat was seen in difficulties on the surface near the USA's eastern coast before it was towed to Cuba for repairs. All three types serve in the Northern Fleet, whilst only the 'Victor I' and 'Victor III' classes serve in the Pacific Fleet.



A Soviet 'Victor I' class SSN in the Malacca Straits during 1974. The large number of personnel seen on the sail structure are sunbathing – a favourite pastime of Soviet sailors at sea or ashore in warm climate regions.

Specification
'Victor I' class

Displacement: 4,300 tons surfaced and 5,300 tons dived

Dimensions: length 93.9 m (308 ft 1 in); beam 10.0 m (32 ft 10 in); draught 7.3 m (23 ft 11 in)

Machinery: one pressurized-water reactor powering two steam turbines driving one five-blade propeller and two two-blade propellers

Speed: 20 kts surfaced and 32 kts dived

Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum

Torpedo tubes: six 533-mm (21-in), two with 406-mm (16-in) liners, all bow

Basic load: maximum of 18 533-mm (21-in) torpedoes, but normally a mixture of eight 533-mm (21-in) anti-ship or anti-submarine, 10 406-mm (16-in) anti-submarine and two 533-mm (21-in) anti-ship 15-kiloton nuclear torpedoes plus two SS-N-15 anti-submarine 15-kiloton missiles, or a total of 36 AMD-1000 ground mines

Missiles: none

Electronics: one 'Snoop Tray' surface-search radar, one low-frequency bow sonar, one medium-frequency missile and torpedo fire-control sonar, one 'Brick Spit' and one 'Brick Pulp' passive intercept and threat-warning ESM system, VHF/UHF communications, one 'Park Lamp' direction-finding antenna and one underwater telephone

Complement: 100

Specification
'Victor II' class

Displacement: 4,700 tons surfaced and 5,700 tons dived

Dimensions: length 100.0 m (328 ft 10 in); beam 10.0 m (32 ft 10 in); draught 7.3 m (23 ft 11 in)

Machinery: as for 'Victor I' class

Speed: 20 kts surfaced and 31 kts dived

Diving depth: as for 'Victor I' class

Torpedo tubes: as for 'Victor I' class plus two 618-mm (24.33-in) bow

Basic load: as for 'Victor I' class but with two SS-N-16 anti-submarine

Missiles: none

Electronics: as for 'Victor I' class plus one towed VLF communications buoy and one floating ELF communications antenna

Complement: 110

Specification
'Victor III' class

Displacement: 5,000 tons surfaced and 6,000 tons dived

Dimensions: length 103.0 m (337 ft 11 in); beam 10.0 m (32 ft 10 in); draught 7.3 m (23 ft 11 in)

Machinery: as for 'Victor I' class

Speed: 20 kts surfaced and 30 kts dived

Diving depth: as for 'Victor I' class

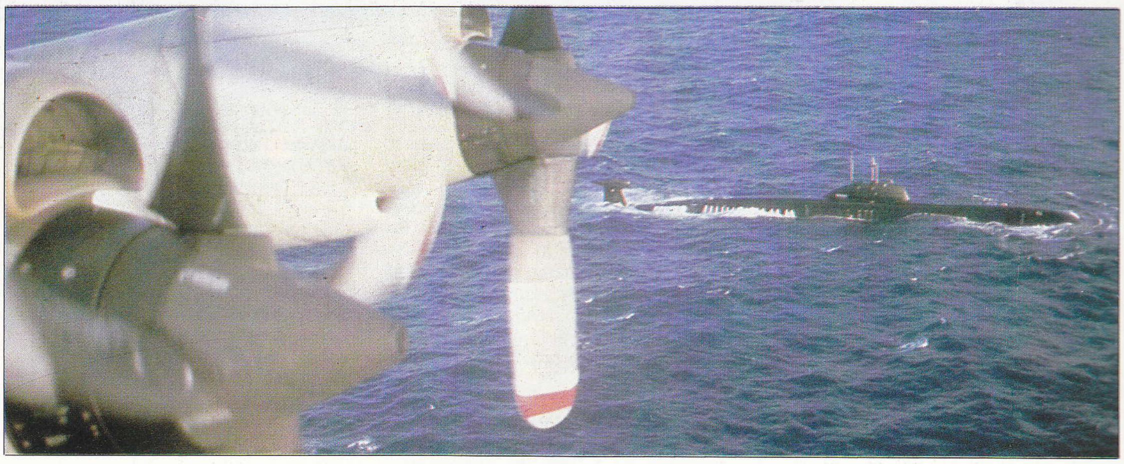
Torpedo tubes: as for 'Victor II' class

Basic load: as for 'Victor II' class

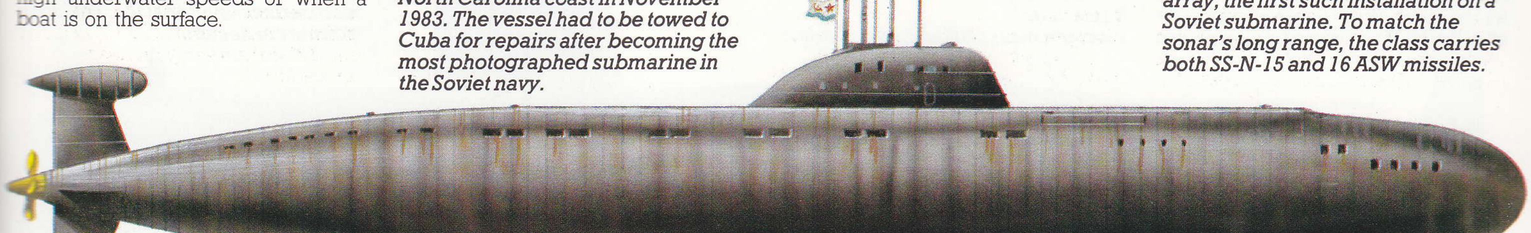
Missiles: none

Electronics: as for 'Victor II' class but with one low-frequency retractable towed sonar

Complement: 115



Above: A windfall for Western naval intelligence, this Soviet 'Victor III' class SSN got into difficulties off the North Carolina coast in November 1983. The vessel had to be towed to Cuba for repairs after becoming the most photographed submarine in the Soviet navy.



Below: A Soviet 'Victor III' class vessel. The pod on the top of the upper rudder is for a towed sonar array, the first such installation on a Soviet submarine. To match the sonar's long range, the class carries both SS-N-15 and 16 ASW missiles.

USSR

‘Alpha I’ and ‘Alpha II’ class SSNs

The prototype of what is the world's fastest and deepest diving operational submarine, the **‘Alpha I’ class**, was launched at the Sudomekh shipyard, Leningrad in 1970-1 and underwent a series of trials with both the Baltic and Northern fleets. Major problems were encountered with both the powerplant and the hull, and the vessel was subsequently cut up for analysis in 1974, then scrapped. The reason for the problems were discovered by Western intelligence to be that the hull was suffering a severe cracking problem as it was constructed from a titanium alloy, a very difficult material to weld successfully, and that the reactor was of a very advanced type using a liquid-metal coolant as the heat exchange medium between the reactor and the secondary steam turbine systems, a type of reactor plant that the Americans had already tested and discarded as being too complex for submarine propulsion. However, by the mid-1970s solutions had been found to the problems, and the class entered slow series production at Sudomekh. A second production line may have started at Severodvinsk in the late 1970s to give a combined total of six or seven completed by mid-1983. The new propulsion plant endows the class with a confirmed underwater speed of 45 kts, which is sufficient to outrun most, if not all, of the current western ASW torpedoes and attack submarines. The Soviets have described the ‘Alpha I’ class as an underwater ‘interceptor’ type with a considerable amount of automation on the machinery side. The titanium alloy hull allows a very deep operational submergence whilst also considerably reducing the magnetic anomaly signature, as the only ferrous materials are in the fittings inside the hull itself. The underwater signature in terms of noise is said to be similar to other contemporary Soviet SSNs at low speeds. The boat is also coated with the ‘Clusterguard’ anechoic coating to reduce the efficiency of enemy active sonar transmissions. All the ‘Alpha I’ class boats serve with the Northern Fleet.

In late 1982 American spy satellites detected a new Soviet attack submarine under construction at Sudomekh. Subsequently assessed as essentially an ‘Alpha’ with a hull lengthened by some 12.2 m (40 ft), it was dubbed **‘Alpha II’ class** by NATO. The new class will be built at two shipyards, possibly Admiralty Shipyard Leningrad and Komsomolsk, as the replacement for the ‘Victor III’ class SSN now in production. The likely reason for the hull extension is to include the SS-N-16 missile system and the towed array technology developed for the ‘Victor III’ class. A capability to fire the new SS-N-21 submarine-launched cruise missile is also probable.

Specification

‘Alpha I’ class

Displacement: 2,800 tons surfaced and 3,680 tons dived

Dimensions: length 81.0 m (265 ft 9 in); beam 9.5 m (31 ft 2 in); draught 8.0 m (26 ft 3 in)

Machinery: one liquid-metal reactor powering two steam turbines driving one five-blade propeller

Speed: 20 kts surfaced and 45 kts dived

Diving depth: 600 m (1,970 ft) operational and 1000 m (3,280 ft) maximum

Torpedo tubes: six 533-mm (21-in), two with 406-mm (16-in) liners, all bow

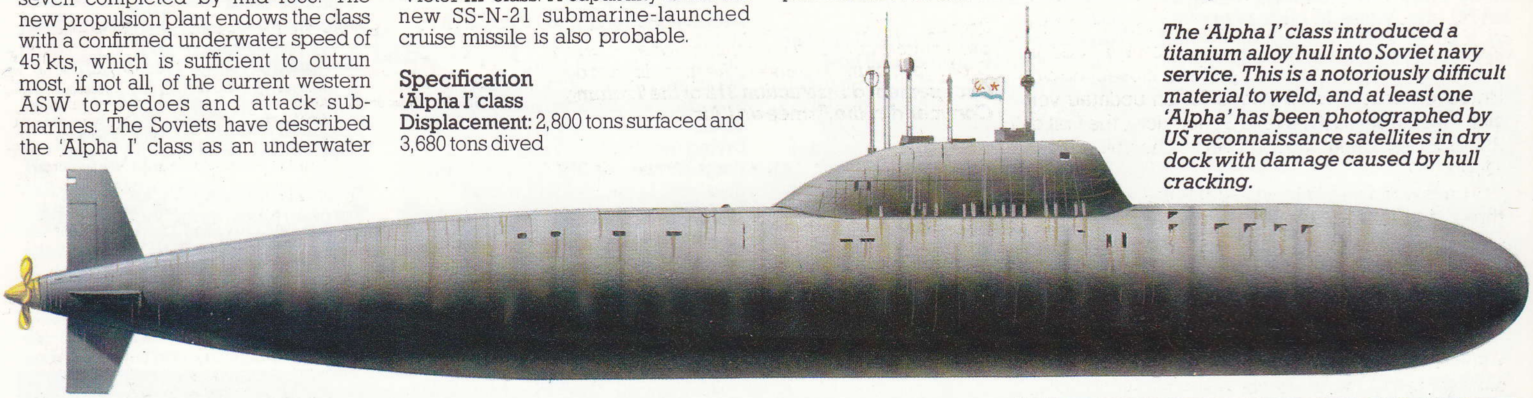
Basic load: maximum of 18 533-mm (21-in) torpedoes, but normally a mixture of eight 533-mm (21-in) anti-ship or anti-submarine, 10 406-mm (16-in) anti-submarine and two 533-mm (21-in) anti-ship 15-kiloton nuclear torpedoes plus two SS-N-15 anti-submarine 15-kiloton missiles, or a total of 36 AMD-1000 ground mines

Missiles: none

Electronics: one unidentified surface-search radar, one ‘Park Lamp’ direction-finding antenna, one unidentified third-generation ESM system, one low-frequency bow sonar, one missile and torpedo fire-control sonar (probably medium-frequency) and one underwater telephone

Complement: 45

An early shot of a Soviet ‘Alpha I’ class SSN, which has demonstrated underwater speed of 45 kts. The ‘Alpha’ class uses a highly automated liquid-metal-cooled reactor plant to achieve this speed.



The ‘Alpha I’ class introduced a titanium alloy hull into Soviet navy service. This is a notoriously difficult material to weld, and at least one ‘Alpha’ has been photographed by US reconnaissance satellites in dry dock with damage caused by hull cracking.

FRANCE

‘Rubis’ class SSN

In 1964 the French authorized the design of a 4,000-ton SSN. This was cancelled in 1968, however, just as construction was due to start. A new and smaller submarine design was then initiated, based on the hull form and overall layout of the conventional ‘Agosta’ class and with basically the same fire-control, torpedo-launching and sonar detection systems. The resulting **‘SNA72’ class** built at Cherbourg is the smallest SSN type in service with any navy, and was made possible by the French development of a small 48-megawatt integrated reactor-heat exchanger system driving two turbo-alternators and a main electric motor. The increased hull depth has allowed the typical three-deck layout of larger SSNs to be used for the areas forward and immediately aft of the fin. The forward diving planes of the Agostas have been relocated to the fin to improve underwater manoeuvrability.

At present two squadrons of these SSNs are planned by the French navy, one based at Brest to cover the SSBN base and the other at Toulon. The first six boats of the SSN programme will be built to the basic ‘SNA72’ design. The first ***Rubis*** (S601), is already in service and the second, ***Saphir*** (S602) is due to commission in 1984. A further five boats will be built to a new design, the first to be laid down in 1988. All will carry versons of the F17 and L5 torpedoes and, from 1985, the underwater-launched encapsulated SM.39 Exocet anti-ship missile.

Specification

***Rubis* (S 601)**

Displacement: 2,385 tons surfaced and 2,670 tons dived

Dimensions: length 72.1 m (236 ft 6.5 in); beam 7.6 m (24 ft 11 in); draught 6.4 m (21 ft 0 in)

Machinery: one 48-mW pressurized-water reactor (PWR) powering two turbo-alternators driving one shaft

Speed: 18 kts surfaced and 25 kts dived

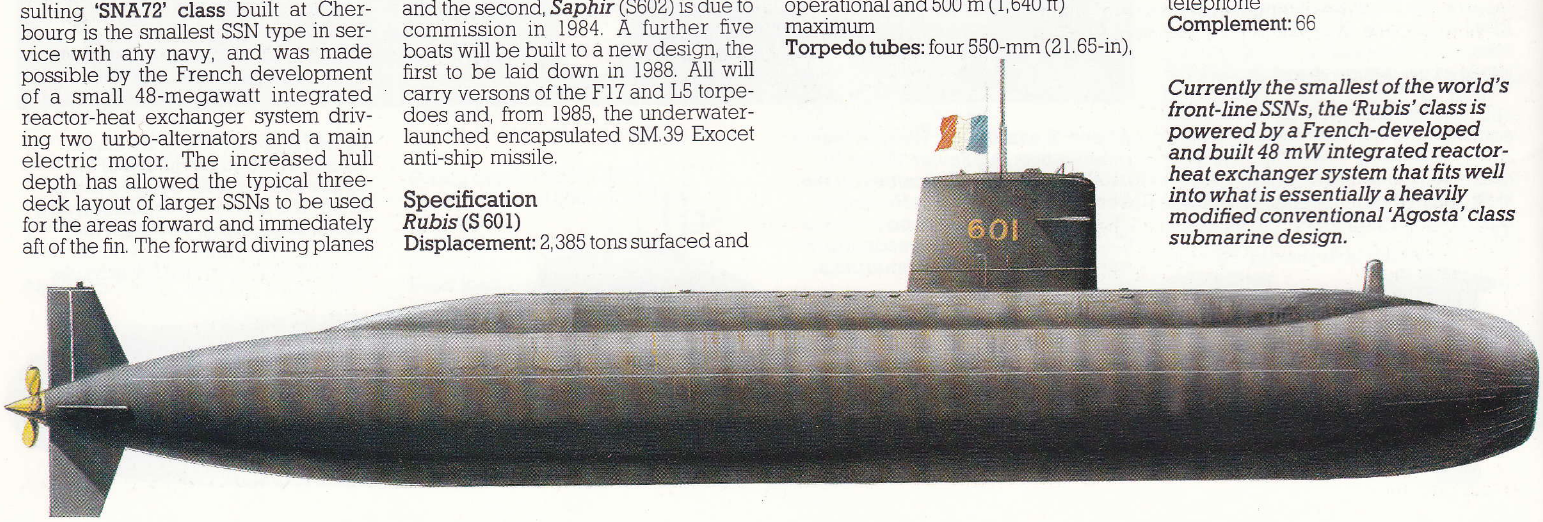
Diving depth: 300 m (985 ft) operational and 500 m (1,640 ft) maximum

Torpedo tubes: four 550-mm (21.65-in), all bow

Basic load: 14 F17 wire-guided anti-ship and L5 mod.3 active/passive ASW torpedoes, or 28 TSM3510 ground mines; from 1985 will be 10 F17/L5 mod.3 and four SM.39 or 28 mines

Electronics: one DRUA 23 surface-search radar, one DSUV 22 passive sonar, one DUUX 2 passive ranging sonar and one TUUM underwater telephone

Complement: 66



Currently the smallest of the world's front-line SSNs, the ‘Rubis’ class is powered by a French-developed and built 48 mW integrated reactor-heat exchanger system that fits well into what is essentially a heavily modified conventional ‘Agosta’ class submarine design.

French Air Force

Non-combatant units

Working in close collaboration with the fighting branches of l'Armée de l'Air are three more commands specializing in transport, training and telecommunications, all of them of vital importance to a high-speed, high-technology air force.

The term 'transport' covers a multitude of varying roles, and for the Commandement du Transport Aérien Militaire (CoTAM) this means strategic and tactical airlift, communications, SAR and general duties by small units supporting garrisons in overseas possessions.

Flagships of the fleet are the Douglas DC-8s employed on long-range or strategic transport flights as far as the French nuclear test centre in the Pacific.

Operating in both long- and short-range roles, the Transall C.160 has been in squadron service since 1967, presently equipping five units with a sixth in imminent prospect. Should this appear to be the result of slow production, it must be pointed out that the last of 53 C.160F variants was delivered to ET 61 in 1963, whereupon the three assembly lines in France and West Germany were closed down. However, orders were placed for an updated version, the C.160NG (Nouvelle Génération), the first of 25 for ET 64 being handed over to the unit early in 1982.

At a lower level, light transports are operated by three units in the Paris area for VIP communications, of which GLAM 1/60, the Groupe des Liaisons Aériennes Ministérielles, regularly carries government officials, including the President and visiting dignitaries.

Most of the rotary-wing fleet is concentrated within EH 67 at five bases, each of its component squadrons having a combination of Aérospatiale Alouette IIs, Alouette IIIs and Aérospatiale Pumas to meet local requirements, such as EH 4/67's responsibility for support and security at the S3 IRBM base. The AA requires 50 Aérospatiale Ecureuil 2s for Alouette II replacement, the first of these having entered service in 1983.

Six overseas squadrons include three with both fixed-wing aircraft and helicopters, although ETOM 58 in French Guyana has a detachment of C.160Fs at its disposal, as has GAM 50 on the island of Réunion in the Indian Ocean. The three Aérospatiale Caravelles of ETOM 82 support the nuclear test site at Mururoa Atoll in the Pacific, whilst ETOM 88 forms part of the French presence defending Djibouti against the territorial ambitions of Somalia.

Training changes

Two basic categories of entrant are trained by CEAA, regular officers and active-duty reservists, the former attending the Ecole de l'Air for a three-year study course which includes 145 to 160 hours of flying in the Aérospatiale Magister. Reservists go first to GI 313 for 20 hours of grading on the Mudry CAP 10 light plane, the fortunate 65 per cent to pass this stage then transferring to GE 315 for another 26 hours on CAP 10s and 64 on Magisters before being 'streamed'.

'Black box' Command

Last of the flying commands, although it has numerous additional ground functions, the Commandement des Telecommunications de l'Armée de l'Air is responsible for aircraft with a primarily electronic role.

France's national air display team, the Patrouille de France, are based with their Alpha Jets at the Ecole de l'Air in Provence. The team is part of Groupement d'Instruction 312 of the Training Command of the Armée de l'Air.

Commandement du Transport Aérien Militaire (CoTAM)

Unit	*Name*	*Aircraft*	*Base*	*Role*
EL 41	Verdun	Broussard, Paris	BA 128 Metz-Frescaty	communications
EL 43	—	Broussard, Paris, Xingu	BA 106 Bordeaux-Mérignac	communications
EL 44	Mistral	Broussard, Paris, N262, Xingu	BA 114 Aix-Les Milles	communications
ELAS 1/44	—	Puma, Alouette III	BA 126 Solenzara	SAR/communications
GAM 50	—	Noratlas, Alouette II	BA 181 St Denis (Réunion)	transport support
ETOM 52	—	Puma, Alouette II	Noumea, New Caledonia	transport support
ETOM 55	Ouessant	Noratlas, Alouette II	BA 160 Dakar-Yoff	transport support
GAM 56	Vaucluse	Noratlas, Twin Otter, Puma	BA 105 Evreux-Fauville	communications
ETOM 58	—	Puma, Alouette II	Pointe-à-Pitre (Guyana)	transport support
GLAM 1/60	—	Caravelle, Falcon 20, Falcon 50, Puma, Dauphin 2	BA 107 Villacoublay-Vélizy	VIP transport
ET 3/60	Esterel	DC-8-60/70	Paris-Roissy	strategic transport
ET 1/61	Touraine	Transall C.160		transport
ET 2/61	Franche Comté	Transall C.160	BA 123 Orléans-Bricy	transport
ET 3/61	Poitou	Transall C.160		transport
ET 1/63	—	Noratlas, N262, Twin Otter	BA 101 Toulouse-Francazal	transport OCU
ET 2/63	Vercors	Noratlas		transport
ET 1/64	Béarn	Transall NG	BA 105 Evreux-Fauville	transport
ET 2/64	Anjou	Noratlas		transport
ET 1/65	Vendôme	Falcon 20, N262	BA 107 Villacoublay-Vélizy	communications
ET 2/65	Rambouillet	Paris, Broussard		communications
EH 1/67	Pyrénées	Puma, Alouette II/III	BA 120 Cazaux	helicopter transport
EH 2/67	Valmy	Alouette II/III	BA 113 St Dizier-Robinson	helicopter transport
EH 3/67	Parisis	Alouette II/III	BA 107 Villacoublay-Vélizy	helicopter transport
EH 4/67	Durance	Puma, Alouette II	BA 200 Apt-St Christol	helicopter transport
EH 5/67	Alpilles	Puma, Alouette II/III	BA 125 Istres-Le Tube	helicopter transport
ETOM 82	Maine	Caravelle	BA 197 Papete-Faaa (Tahiti)	transport
ETOM 88	—	Alouette II, Noratlas, Broussard	BA 188 Djibouti	transport
CIEH 341	—	Puma, Alouette II/III Dauphin 2	BE 725 Chambéry-Aix les Bains	helicopter OCU
EdC 70	—	N262, Noratlas, Broussard	EAA 601 Châteaudun	aircraft ferrying

Commandement des Ecoles de l'Armée de l'Air (CEAA)

Unit	*Name*	*Aircraft*	*Base*	*Role*
EC 1/8	Saintonge	Alpha Jet E	BA 120 Cazaux	weapons training
EC/28	Nice	Alpha Jet E		weapons training
GI 312	Ecole de l'Air	Magister		basic training
		Alpha Jet E		Patrouille de France
		CAP 10/20	BE 701 Salon-de-Provence	aerobatic training
		Jodel 140		grading/sport flying
		Noratlas, Broussard		transport support
GI 313	Ecole des Moniteurs	Magister	BE 745 Clermont Ferrand-Aulnat	instructor training
		CAP 10		grading
GE 314	Ecole de Chasse	Alpha Jet E	BE 705 Tours-St Symphorien	fighter school (advanced training)
		Broussard		communications
		Paris		communications
GE 315	—	Magister	BE 709 Cognac-Chateaubernard	basic training
		CAP 10		elementary training
		Broussard		conversion flight
GE 316	—	Noratlas	BA 101 Toulouse-Francazal	navigator training
GE 319	—	Xingu	BE 702 Avord	twin-conversion

Commandement des Transmissions de l'Armée de l'Air (CTAA)

Unit	*Name*	*Aircraft*	*Base*	*Role*
EE 51	Aubrac	DC-8Sarig	BA 105 Evreux-Fauville	signals intelligence
EE 54	Dunkerque	Noratlas, Puma	BA 128 Metz-Frescaty	ECM/jamming
EdC 57	Commercy	Noratlas, Falcon 20	BA 107 Villacoublay-Vélizy	calibration

Etat Major de L'Armée de l'Air (MAA, or Air Staff HQ)

Unit	*Name*	*Aircraft*	*Base*	*Role*
CEAM	—	various	BA 118 Mont-de-Marsan	military trials

(incorporates CAFDA-controlled EC 24/118 and transport support aircraft of ETL 26/118)

Abbreviations

BA	Base Aérienne (air base no.)
BE	Base Ecole (school base no.)
CEAM	Centre d'Expérimentations Aériennes Militaires (military aircraft experimental centre)
CIEH	Centre d'Instruction des Equipages d'Hélicoptère (helicopter training centre)
EAA	Entrepôt d'Armée de l'Air (air force depot)
EC	Escadron de Chasse (fighter squadron)
EdC	Escadron de Calibration (calibration squadron)
EdC	Escadron de Convoyage (ferry squadron)
EE	Escadron Electronique (electronic squadron)
EH	Escadron d'Hélicoptères (helicopter squadron)
EI	Escadron d'Instruction (instructional squadron)
EL	Escadron de Liaison (liaison squadron)
ELAS	Escadron de Liaison et de Sauvetage (liaison and SAR squadron)
ET	Escadron de Transport (transport squadron)
ETOM	Escadron de Transport d'Outre Mer (overseas transport squadron)
GAM	Groupe Aérien Mixte (mixed aircraft group)
GAEL	Groupe Aérien d'Entrainement et de Liaison (air training and liaison group)
GE	Groupement École (school group)
GI	Groupement d'Instruction (instructional group)
GLAM	Groupe des Liaison Aériennes Ministérielles (government air liaison group)